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TABLE OF CONTENTS

Principles and General Observations

Introduction 1
- Hart Haidn

Problem Solving Requires Inclusive Thinking 5
- John Ralston Saul

The Case for Science and Technology in Agriculture: From Destruction to Wisdom 23
- Carolyn Raffensperger

Keeping Family Farmers on the Farm – Sustainable Agriculture: Not an Alternative but the Future 31
- Jim Horne

The Dilemma of Biotechnology 41
- Michelle Brill-Edwards

Causes of the Recurring Farm Crisis

The Root Causes of the Farm Crisis 51
- Brian Halweil

The Farm Crisis and Corporate Power 63
- Darrin Qualman

Resisting Change: Challenges for People and Organizations 69
- Hart Haidn

Sustainable Solutions

The Search for Solutions – A Need for a Paradigm Shift 81
- John E. Ikerd

Systems for Sustainable Agriculture: Approaches, Tradeoffs and Needs 95
- David G. Patriquin

Hallmarks of Sustainable Farming Systems 105
- John E. Ikerd

Organic Farming and Sustainable Agriculture 115
- Mary A. Beckie

Sustainable Solutions (cont'd...)

Working with the Process of Change, Particularly Psychological Process, When Implementing Sustainable Agriculture 125
- *Stuart B. Hill*

Achieving Agricultural Sustainability in Australia by 2020: A Social Ecology Framework 135
- *Stuart B. Hill*

History of Growth and Research Priorities for Sustainable Agriculture in the United States of America 141
- *James Horne*

Organic Industry Needs Assessment: Results of Workshops and Questionnaires 147
- *by Desiree Jans, Saskatchewan Agriculture and Food*

Production

Soil Fertility Research for Low-Input and Organic Farming Systems: U.S. Projects, Perspective 157
- *Lynne Carpenter-Boggs*

Enhancing Soil Fertility in Organic and Low-Input Agriculture 161
- *Lynne Carpenter-Boggs*

Biodiversity in Soil: Interactions with Agriculture and the Role of Agriculture in Problem-Solving 165
- *Lynne Carpenter-Boggs*

The Role of Forages in Sustainable Agriculture 171
- *Zoheir Abouguendia*

Apple Production on the Prairies: It Can Be Done 177
- *Rick Sawatzki*

Intercropping to Balance Soils and Pests on Organic Farms 179
- *Janine Gibson*

Economics

Economics, Ecology and Sustainable Agriculture 183
- *David Granatstein*

Organic Agriculture Faces the Specialization of Production Systems; Specialized Systems and the Economical Stakes 195
- *John E. Ikerd*

Sustainable Farming and Rural Community Development 207
- *John E. Ikerd*

Economics (cont'd...)

Organic Agriculture and Sustainable Communities: Creating Sustainable Rural Communities and an Optimistic Future for the Next Generation 223
- *Cornelia Butler Flora*

Environment

Prairie Agriculture, Climate Change and Sustainable Alternatives 241
- *Suren N. Kulshreshtha*

Revisiting Carrying Capacity: Acre-Based Indicators of Sustainability 263
- *William E. Rees*

Regulatory Framework

The Seven Deadly Threats to Organic Integrity 283
- *Patrick Holden*

The Need for an Efficient Regulatory System for Organic Production in Canada 287
- *Darryl Amey*

Food Health

Does Organic Production Provide for a More Healthy Food Than Non-Organic Production? Report on a Dutch study, with some additional comments 291
- *Jan Diek VanMansvelt*

Putting Breast Cancer on the Map 303
- *Helen Lynn*

Reducing Risks from E. coli on the Organic Farm.. 309
- *David G. Patriquin*

INTRODUCTION

— HART HAIDN —

Every needs assessment done for organic farming or sustainable agriculture tells us that education and access to information is on the top of the lists.

In February of 2001, Agriculture and Agri-Food Canada released its paper on sustainable agriculture with the title: "Agriculture in Harmony with Nature II – Agriculture and Agri-Food Canada's Sustainable Agriculture Strategy 2001 - 2004". It is broken down into a number of different sections and each ends with basically the same recommendations: *it is recommended to improve awareness and education.*

For three years I have organized the organic conferences in Saskatchewan to achieve a number of things: to raise the awareness about issues of sustainable agriculture and organic farming and to provide elements of education to a wide variety of people with different interests. We will continue this process with this publication.

Sustainable agriculture is a term, which cannot be described with any accuracy. Agriculture and Agri-Food Canada has adopted our notion that: "…sustainable agriculture is a goal towards we are striving". All we can do is to explain what we try to accomplish when we claim to 'work to make agriculture in Canada more sustainable'.

We like to see agriculture become economically viable in all sectors

For quite some time, we have witnessed that the input and marketing sectors are doing really well, while the farming sector stumbles from one income crisis to the next.

Darrin Qualman, the Executive Secretary of the National Farmers Union, completed a study last year, which shows how the concentration of the economic power in the input as well as in the marketing sectors, have made farmers more and more dependent and why this is indeed one of the root causes of the recurring farm crisis.

None of this is new; this trend exists since industrialization of agriculture began. Jim Horne gave us a quote from Abraham Lincoln: "*I see in the near future a crisis approaching that unnerves me and causes me to tremble for the safety of my country.... corporations have been enthroned and an era of corruption in high places will follow, and the money power of the country will endeavor to prolong its reign by working upon the* *prejudices of the people until all wealth is aggregated in the few hands and the Republic is destroyed."*

Qualman's findings agree with the work of other researchers. Cornelia Butler Flora discusses this aspect in her presentation as well. *"The recent push toward consolidation, as seen in financial services, telecommunication, and automobiles, is also occurring in biotechnology, food processing, and distribution."* However, she also gives us a good idea which way farmers and rural communities can go to revitalize their economies.

Brian Halweil uses in his presentation a graph, which I have used many times as well, because it illustrates this phenomenon, and because it also gives us indications how we can solve some of the problems. The shrinking share of the farming sector in the entire agricultural economy has not only reduced farmer's options and potential for income generation, it has also made farmers more dependent on forces beyond their control. The good news is that this dependence can be broken. We have to find solutions to re-capture some of the ground lost to the input and the marketing sectors.

We like to see agriculture to be socially responsible and support the public good

I am asked frequently about the social dimensions of agriculture. There are many, but as John Ralston Saul says, *"Economics cannot lead society if we consider the importance of the public good. It certainly cannot lead agriculture."*

What he is getting at is this: Agriculture in its broad sense is intertwined with most aspects of life, or if you will, social and activities. Agriculture greatly influences the natural environment and human health, to say nothing about the economy. Because of this, the goals in agriculture must be set with the greatest public good in mind.

This means, that we cannot allow a few transnational corporations dictate the course agriculture should take. More consideration has to be given to the protection of the environment, human health and the well being of rural communities and the viability of farming.

Before the conference in 2000, I attended a meeting organized by Saskatchewan Agriculture and Food and the Regional Health District in Humboldt. This meeting was about the question 'how we can deal with the farm crisis.'

Over ten years ago I chaired the National Farmers Union's Farm Crisis Committee in the Peace River Region. At that time I compared the crisis with a rising flood, which drowns the valley bottom first, and slowly swallows the farms on the side of the hills. The farmers higher up feel safe because they cannot imagine that the flood will ever endanger them. The farmers who are in crisis now, are like the ones in my metaphor, who felt safe ten years ago.

To see the frustration and anxiety in the faces of these farmers now is an indication of the social unsustainability of the predominant systems of agriculture.

This tells us that the problems are systemic, and that an improvement of the situation cannot be accomplished by doing things just a bit faster, bigger or investing more capital.

One aspect of social justice we often tend to forget is the impact we have on developing countries. As Bill Rees says: "*The wealthy already consume on average three times their fair share of sustainable global output. Since additional material growth in rich countries would appropriate additional carrying capacity further reducing the ecological space available to poor countries, it is both ecologically dangerous and morally questionable. To the extent we can create room for growth, it should be allocated to the third world.*"

(1) We like to see agriculture to be ecologically sound

The environmental connection between farming and the environment is obvious. The loss of biodiversity as well as the pollution of soil, air and water is directly related to the intensity of farming. But there is more.

Surendra Kulshreshtha says: "*Prairie agriculture in 1990 contributed 41.9 million tonnes of gases (in terms of their global warming potential), which were over half of the Canadian total emissions of these gases from agriculture. By 2010, these emissions are expected to increase by 17% if soils as carbon sinks are not recognized, and by 4% if these are*".

What is often forgotten is that the negative impact on the health of the environment and humans is also related to the marketing sector. Over-processing, over-packaging, the often senseless transportation of food and commodities – they all take their toll.

Bill Rees's model of the Ecological Footprint makes us understand our role and the dangers in altering the environment so much better. Because of the simplicity of this concept it is easy to understand by those who want to understand.

We like to see agriculture to be able to offer the same or better opportunities to following generations

One of the disturbing symptoms of industrial agriculture is the loss of young people in rural areas. They leave the farms and their communities because they see no future there for themselves. This must not be so.

We can observe a renewed interest I farming by children who grow up on farms and ranches, which have made the transition to more sustainable practices. The Bennett Ranch in Meacham, Saskatchewan, is such an example. We also can see the revitalization of rural communities resulting from slowing the drain of financial resources by becoming less dependent on external inputs.

But intergenerational equity also means that we have to clean up the environment and reduce all risks to human health as much as possible.

The future is in sustainable agriculture

Thousands of farmers in Saskatchewan alone have made the successful transition to more sustainable practices. They have defied the odds and have overcome many of the barriers.

Some of the barriers are very difficult to conquer. Stuart Hill says: *"It is common for proposals for change, which usually imply criticism of current practices, to bring up fear and a diverse range of defensive behaviours. These extend from withdrawal, non-compliance and argument to ridicule, angry confrontation and even violence."*

It is safe to say that in the hierarchy of barriers to change, the psychological barriers are not only the most difficult one to overcome, but they influence most of the other barriers as well.

Policy development and decision-making has to consider a much longer time frame and not just the short-term. Many of the problems in agriculture could have been anticipated with some careful analysis. Some damage could have been prevented if we would not have accepted the rush into new technologies. The same is true for our situation today. The questions we have to ask are: do we if we need any of the new technologies as they develop, or should we rather take the time to study them as long as it takes to be sure they are not only safe but also beneficial to the farming sector and society as whole?

Unfortunately the voices of reason are often drowned out by the hype created by claims of 'progress'. Or criticism is often silenced before it can be heard. John Ralston Saul describes one other group of barriers this way: *"Even being slightly original will probably damage your career. Openness will be punished in our society."*

John Ikerd has written a lot about many different aspects of sustainable agriculture and says, that nothing less than a major paradigm shift is required: *"The new paradigm considers the economic, ecological, and social dimensions of sustain-ability to be inseparable. Fields, farms, and communities are con-sidered to be wholes that are made up of smaller wholes and make up still larger wholes. Thus, the approach to farm decision-making and management must be holistic."*

In other parts of the world, developing sustainable alternatives in agriculture is more advanced than in Canada. Canada has indeed lost ground in the area of some key issues. Susan Fowler, Jan Diek VanMansvelt and Hart Haidn, Jim Horne and Stuart Hill describe, what has happened in other countries.

Searching for solutions in agriculture requires inclusive thinking, as Saul suggests. It also requires that we understand the barriers we have to overcome.

To raise awareness about problems and solutions is our mandate. We have been rather fortunate to attract a wide range of well-respected farmers, scientists and educators to our conferences. This book offers you a selection of their presentations.

The future will be in sustainable agriculture, because we know that reason will eventually prevail – we have no other choice.

PROBLEM SOLVING REQUIRES INCLUSIVE THINKING

— JOHN RALSTON SAUL —

The following presentation was given at a special evening session of the 1999 conference. It was taped by one of the conference participants, Erland Sundby, and this tape found its way to me in winter 2001.

The taped version was transcribed and then edited. In doing so, I tried to stick as close to the verbal presentation as I could.

— Hart Haidn, May 2001

Good evening. It's really great to be back here. Thank you for the marvelous sunset I saw on the way in. You don't get those where I'm living at the moment, but I remember them from the three or four times that I've been out west on the prairies. So it's a great feeling for me whenever I see it, because it reminds me of an argument which I'm not here to talk about tonight - well, I guess I am indirectly. That argument is that this is one of the few countries in the developed world where the concept of animism still means something. It means something because we still live in a place where we are conscious of the fact that no matter how sophisticated we think we are we know we don't control a place because the place is uncontrollable. And this is a very simple but interesting idea that is forgotten in most of Europe, the United States, a good number of our universities, and in fact, in general, in the educated corners of our society. It is the idea that human beings are not actually in control.

It was very kind of Hart to invite me tonight, however, apart from losing at the vegetable growing competitions on a regular basis at various schools in my youth, I am not an expert on the subject of agriculture.

I came across a quote from Einstein the other day, which said: *"in a crisis imagination is more important than knowledge."* That is not a soft and gratuitous comment, coming from somebody who didn't believe that imagination was a soft and gratuitous thing. Imagination was his work tool and knowledge was just a sort of grease for the tool. But the real important thing was imagination. And you could often, outside of a crisis, get by pretending imagination didn't matter, but as soon as there was a crisis, all was lost if you weren't able to call upon imagination. I guess I wanted to start with that quote because when you understand that imagination is more important than knowledge, you understand that maybe we really aren't teaching things quite right in our formal education systems.

You also understand why economics - whatever your economics – aren't really capable of leading society. They can't lead society because economics as they are applied are pretty short on imagination. They don't have much access to imagination. Economics have a great deal more to do with self interest, with utilitarianism, and that's why when you look through the history of western society, what you discover is that there isn't a single example of a society, a democracy, or sophisticated evolved society being led by economics. And suddenly there was this 'discovery' about 20 years ago that societies could indeed be led by economic forces. A very interesting 'discovery' because it wasn't accompanied by any new information, which would have indicated that after 2500 years of civilization we can do it differently. It was the notion that we can put the marketplace in charge and it will lead the way. This has never been done before, successfully. And when it has been tried it usually lasted for a very short time, then it burned out.

The only exception to the rule that I can think of is Venice, which did last a long time. To understand the nature of Venetian society, you look at it and see the wonderful paintings, wonderful music, wonderful garish architecture, because it was very nouveau rich business oriented society at the time. The funny thing is that there was one important element missing from Venetian society – nothing was written. No literature, no ideas, no philosophy, no poetry, nothing, until you get to the completely degenerate end of Venice when suddenly a bit of playwriting appears. And what that tells you, is that this wasn't a democracy, this wasn't a place where language, where discussion amongst citizens was valued. In fact, what was valued was being a loyal citizen, which meant you might on occasion put an anonymous letter through a slot of the government front door to denounce a neighbor.

So that's the only successful society of the western tradition where economics led. If you really like paintings and don't care about the rest, than I guess it's not a bad example. However, I am not engaging in the gratuitous attack on the marketplace, quite the contrary. I think it is also true that there is no example in 2500 years of a successful society that didn't have an open marketplace. Open in the sense, that capitalism or competition played a role. It has always been there. What is interesting is that consideration of the marketplace has always been at the third or fourth level. It's been at the third or fourth level for two reasons: 1) it's really not capable of being at the first or second level, and 2) it does best at the third or fourth level.

The market place is very bad at leading society and the reason is very simple. The reason is that the strength of the marketplace, the strength of capitalism, is rather romantic. The marketplace doesn't have much of a memory, it gets awfully excited really fast, and runs away with new ideas, and gets overheated, and explodes, and then collapses. Free markets are about boom and bust. Therefore it isn't really capable of leading a sophisticated, evolved society, because we can't live in a place, which is boom and bust all the time; we would not be able to rely on the fundamental needs in life. We would starve, not get heated, and we would have no protection from threats to our health and livelihoods.

We require long term, inclusive thinking and planning. This slows processes down. And the more democratic a society is, the slower and more stable it is. In fact, some of the characteristics of a democracy are that it is slow, boring, inefficient, time wasting and solid. And that solidity at the top level allows us to have a marketplace that can be romantic, and overexcited and unstable. It prospers precisely because we lead it - the citizens lead society and provide a certain kind of frayed stability within which it can do well at its proper level, which is below culture, below society, below the public good. It is peculiar that not more people are saying this today.

What I have just done here is an introduction to making a pro-free market argument by saying the market shouldn't be in charge. In other words, you can't say that this is a classic left wing argument, and it clearly is not a classic right wing argument. What it really is, I think, is a description of the historical reality, which we have lived. And to allow the marketplace to be in charge is to betray 2500 years of history, to say nothing of 150 years of Canadian history.

Now let me talk about something which is in the context of what you are discussing at this conference: how economics and agriculture work in the marketplace.

I'm going to try to break it up into four parts. One has to think about economics in a really clear way. First there is a marketplace that historically - 19th and 20th century - was a form of industrial and financial activity and risk taking. This was the classic market system or Smithian marketplace.

Then there was a second kind of marketplace, which I think is really in charge today. This is essentially the managerial corporatist system. What I mean when I say corporatist, is a society in which we don't exist principally as responsible individuals. We exist principally as members of interest groups and specialist groups, which include private corporations, but also government corporations, writing corporations, and so on. That society is seen as something, which is made up of interest groups and specialist groups run by having constant negotiations between them to see who gets what. I think that this is the way we run society today.

From this follows that I think that what we call the marketplace today isn't actually the capitalist marketplace at all. It's a managerial corporatist marketplace run by managers pretending to be capitalists. All those people telling us to take risks today are, when you look closely at them, employees of corporations - which is to say bureaucrats which hold shares which they got as part of their pay. So they aren't capitalists in any real sense, they are managers. Then there is the third kind of marketplace, which is the commodities market. The commodities market has always been the most unstable of markets, particularly the non-agricultural commodities market. When you look at the rise and collapse of democracies in Latin America in the 1920s and 1930s, you will find this has been because they were overly dependent on commodities and on the export of commodities. Juan Peron rose to power because of Argentina's success in exporting commodities. The more they exported, however, the more unstable society became and this essentially led to the rise of fascism. It is an interesting thought that success in the export of commodities could lead to the collapse of a society when we live in a time when we are suppose to believe that the export of goods at any cost will lead to prosperity.

The fourth group, which is agricultural commodities, comes closest to what you are talking about today. Farming of course has an element of instability in it because of its dependence on seasons and markets. But at the same time it has an element of great stability in it because of course it's tied to farmers who own land, and therefore, are the most stable thing you can have. They are actually stuck there, on the land, whatever the seasons or the markets. So it is an astonishing combination of extreme stability with the possibility of extreme instability.

I think, that kind of tension between the two extremes - stability and instability - is the particularity of agriculture, which makes it interesting, depressing and exciting. But it also means that probably farmers are playing a different role in society than other kinds of people. They play a different role because they are living a very different kind of life, because they are living with tensions that not even an owner of a high-risk corporation could really understand. In a high-risk corporation you risk at the beginning and then you get established; in farming, every year is a repeat of that same tension of high stability and high instability.

This has been the situation for 2500 years. I say for 2500 years because people always think this recognition is brand new when in fact, almost everything we're doing today has been discussed for some time. Decisions have been made on these subjects in societies all over at all times. Technology changes things from time to time, but it doesn't change the nature of the discussion.

I promise that if you took out a few of the words from what I am going to say tonight and from the things that you have been talking about over the last few days, that you would find that it's a kind of discussion that could have taken place in 1870 in Vienna, in the Austrian-Hungarian Empire. I say that because Vienna was a place which resembled Canada in some ways - highly centralized, many cultures, many languages, a great deal of confusion, quite interesting and not boring - constantly talking about how boring it is, but not boring at all.

What we find is that agricultural commodities, in order to deal with this tension, have always been managed and manipulated. They have never been, in a sophisticated society, left to the vagaries of the normal commodities marketplace. It has always been understood - it has been understood by the government of

Athens, understood by the government of Rome - that you had to manage agriculture in order to make sure that you got some sort of balance between stability and instability. You can find these arguments again throughout the history of the British Empire.

Now suddenly it has been suggested that the marketplace could handle on a yearly basis, not only the price of grain, but also what would happen to the land and to the people who produce food. This is to suggest something very radical, something we have never experienced in history before. This would be fine provided it had something new to bring to the table to suggest that there is a good reason to make a radical change. I haven't seen what that would be, except that it is good for a few. In fact, what I see coming more and more are reasons to think that things should be managed, not in a corporatist managerial way, but managed in a sense that agriculture and the land are part of the public good. They are tied to the public good, and therefore have to be managed within the concept of the public good.

So why am I going on and on about this? Well, I think what I have just described to you in these four categories is central to what we think about our recurring agricultural crisis - because there clearly is one, not only in Canada, but also in Australia, in the United States, in Europe. Interestingly enough, there is a slight variation in each country's agricultural crisis, in every western democracy. There is also an environmental crisis, and there is also a crisis about the relationship between agriculture and the environment. So it's not particular to Saskatchewan, to Canada. It's common throughout the developed countries.

Economics cannot lead society if we consider the importance of the public good. It certainly cannot lead agriculture. And let me just take a tiny pause, and I think this is the only thing I am going to repeat from what I said last when I was in Saskatoon. But it is worth repeating. When I said that because of this peculiar tension between stability and instability, farming communities played a very particular role in the public good it is worth remembering that, very specifically in Canada, this country was defined in it's modern form between 1900 and 1911 by the farmer's movement on the prairies. And the defining moment for this country in its modern form came when Wilfred Laurier, the great Prime Minister, took his train trip in 1910 across the country and stopped at every railway station. He was a very interesting guy, and he thought he was basically being thanked for helping to open up and organize the prairies, which he did. What he hadn't expected was that in every railway station he would meet this new farmers movement, which was the intellectual cutting edge of the country of the time, and they would explain to him how the country should be reorganized.

Essentially, their platform became the platform of Canada for the 20th century. Which is to say they put forth the idea of this new agriculture, of how to organize stable managed markets. They talked about a national accounting system, which would turn into transfer payments. They talked about decentralization, and all of that led into a whole idea, again out of the West, of what Nelly McClung would call the fair deal, the idea of the fair deal which would lead to women's rights and to Medicare. All of that came not simply out of the West, it came out of the farming communities of the prairie provinces; nothing more than the reform farmers movement platform of 1910. I don't say that to insult anyone. I say that to show how successful the farmers were in defining what the country would be.

Let me go back now to that idea of management versus managerialism. When I talk about a managed economy, agriculture and the land within it, and therefore new and interesting ways of avoiding the problems in and with agriculture, I am clearly not talking about a society dominated by managerialism.

Another great contribution of the farming community was that from the beginning they understood that education, knowledge, imagination and thinking would be similes, metaphors, for democracy. So really, and this predates the west, it were the uneducated, illiterate farmers of upper and lower Canada that pressed Lafontaine and Baldwin - the creators and leaders of democracy in this country - to make education stand as an equal element with democracy in the building of the country. And out of that came a great victory, which was the great victory for education. We have higher levels of education in this country than almost any other country, and higher levels than have ever been seen before in the world.

Yet, the result of it is that when we talk about knowledge today, we don't talk about the public good. The farmers, pushing their politicians, created our education system out of the concept of the public good. Today when we talk about knowledge, we principally talk about it as the knowledge economy.

So you see, there is logic to my madness and this is all leading together. We only talk about knowledge as if it had solely an economic, utilitarian value - that you get knowledge in order to make money. That would be bad, but maybe not so bad if the following did not happen. The following being that the citizens through their taxes - because we pay most of the public money while very little is paid for by the corporations - pay for the education system that educates you and the rest of the society. In other words, you pay for the amplification of our knowledge and our imaginations. And then what happens the moment each one of us graduates and goes into employment?

The employment contract basically buys your knowledge. It buys your body with what it contains, which is the knowledge

John Ralston Saul
(photo by Darryl Amey)

that the citizens paid for you to get. So it's like a sort of kidnapping of the public good, the common good. I am not criticizing that. What I am criticizing is a society, which is willing to accept an idea, the corporatist idea, that an employment contract is more important than the public good. That private interest or government interest should be able to purchase something that is as important as democracy for utilitarian purposes. Purchase the knowledge of a citizen so it cannot be used in an open way, in a public debate.

So that when we have debates on important issues like what kind of farming, what kind of agriculture we should have, the people who actually have the knowledge on these subjects are the people who are unable to speak up. Why? Because they either work for governments or for private corporations or for courtier organizations like lawyer organizations or consultant organizations that want to get money from the two main employers. Therefore, the people who actually have the knowledge are unable to speak up which leaves the floor free for people like me, and a couple of others. This may be okay for me, but I don't think it's okay for society.

Frankly I would much rather see the floor filled with the people who we indirectly paid an enormous amount of money to so that they could know these things on our behalf and speak openly about them. For example, whether agricultural runoff is the kind of problem we think it is and what we should be doing about hormones and antibiotics in raising livestock. I want to hear this debate.

We can't hear the debate from the people who know, because the public and private corporations of this country have kidnapped them, so to speak. And this is a very big problem for a functioning democracy of any kind, on any subject. This is why it is very easy to deny or ignore the problems on an almost daily basis. And I am sure that this is what you were partly talking about earlier today. How can you have a debate if you can't get the debate to happen with people who should have the knowledge, and who are either directly or indirectly working for us, or benefiting from us?

What I am saying is that an employment contract can mean that you are punished if you speak out in a manner that is other than in accordance with the corporation. Even being slightly original will probably damage your career. Openness will be punished in our society. Helping the debate will be punished in our society. What that does is reinforce, what I called in my book the rational idea, the corporatist idea, the linear idea, and the anti-individualist idea.

This means that an expert exists within a group of experts in order to discover the truth, and that truth will then be announced to us in a religious manner, and we are expected to go along with it because they know. It also means there will be no debate on the subject of any meaningful sort; there may be newspaper debates, television debates, but there won't be any meaningful debate of any sort because it won't be permitted among the people who actually have an expertise in the area.

These experts are obliged to put themselves forward as those who carry the truth and present themselves to the public as having the truth. They give up their real freedom as an individual, and in return for that they are allowed to pretend to be a sort of messiah like figure, whether it's a messiah on some new technology or chemical invention, or a messiah like figure on some medical or economic question. It really doesn't matter what the question is.

The message they have is presented as the absolute truth, and there can be no argument - therefore it carries the air of inevitability. And that's why, again and again over the last few years, every major innovation that is put forth or being put forth is done so as if it is not only true, but also inevitable, and there is nothing you can do to stop it, it is going to happen anyway.

Truth and inevitability are of course two ways of describing ideology. New agricultural methods, which are being put forward as being the only possible and inevitable thing, is in fact, ideology, even though it is minute, it is still what you would call shrunk ideology. But, of course, it can have an enormous impact on us no matter how small it is. Little ideologies, little technological breakthroughs that are ennobled in our society by being treated not as technological breakthroughs open for discussion, but are treated as being truths.

And all of that is tied to our misunderstanding of what progress is. I consulted the dictionary to understand what progress is, which is what I think you are wrestling with this weekend. At the end I came back to the thought that it couldn't be as simple as technological breakthroughs. Those are not really progress. They are just technological breakthroughs, often seen without larger context. Surely progress was something that was with us from the beginning and is still with us. Eventually I came up with a kind of Tolstoyesk version of progress, which was the one thing that we can measure our movement as a society through. One example is, what we do with water.

You can actually see the rise and fall of civilization - because after all, if progress were a single line then you wouldn't have had the Dark Ages, you wouldn't have had the Second World War. Clearly progress goes in some curious way, and the technical stuff just goes with the cycle. What you can find is that when societies rise, societies that are going to last for a long time, they rise along with an understanding of how to deal with water. That is, how to respect the value of water, how to use it without wasting or poisoning it, so that it can be used permanently.

The Roman society rose, while amazing engineers learned how to use water, running hot and cold water in and out of houses in large towns. Running water - a couple of thousand years ago – was no problem at all. And then as they poisoned the water, the society declined, and fell apart. You can see the same thing with early Islamic society. In the eighth and ninth century you could see cities in Egypt with the most modern, astonishing running water systems and ways for cleaning water by running it through porous rock. You can go today to Morocco and see an 11th century running water system, which has changed very little. But then you see that whole society go into decline as they fouled their own water.

Then you look at our society which is highly sophisticated, just like the late Roman Empire - excuse me for putting it this way - and you note that it is considered to be fashionable to drink bottled water. And you think: is that really a fashion or is it because we have fouled our water? Therefore, even in a country like Canada, which has all of this incredible fresh water, we drink bottled water.

And the hype can be seen in the fact that the larger the city, the more likely it is that they will be drinking water in bottles imported from Italy and France - two of the four countries in western democracy with the most polluted water tables. So you're actually at a level of high delusion in terms of what you are doing. I am not directly insinuating anything. I am just pointing out that if I was going to drink bottled water I don't think I would choose bottled water from Europe, if anything, because of the quantity and the population per square foot and what that implies in terms of toilets and sewer systems. I would probably use Canadian bottled water. We wouldn't have to bring it across the Atlantic. The thought of bringing bottled water across the Atlantic to drink in Canada: just think of the delirium. I think if we were describing that taking place in Rome in the fourth century, we would describe that as a sign of decline.

It's very hard to come to terms with what truth is and how you deal with it when you are so far away from dealing with progress in a sensible manner. Not in an ideological manner, not in a right wing or left wing manner, not in a romantic manner, just in a plain old down to earth sensible manner.

I do think there are interesting things happening now, they have been happening for the last couple of years. We are starting to see what you would call breakouts in which people who belong to corporations actually take the kinds of risks that they weren't taking five years ago. Five years ago, ten years ago, there was virtual silence among the functioning elite's of the western democracies.

The case of Dr. Nancy Oliviery, a physician and renowned expert in blood disorders at Toronto's Hospital for Sick Children, is such a very interesting outbreak - breakout - not only because this extremely courageous young women did what she did, but because something like 30% of the intelligent young doctors at the hospital backed her. It was a sign that they were willing to risk their careers. They didn't really win in the end, but they didn't exactly lose either. So it was a very positive sign that things might happen.

The case of Dr. Pusztai in Scotland, who detected some problems with genetically modified potatoes, is also a very interesting incident. Somehow cracks appeared in his work and he broke through the crust, which he considered solid ground. But something interesting is happening. The very fact that he wasn't completely destroyed as an individual, which he would have been ten years ago, is also a very positive sign.

The fact that 200 scientists in the Health Protection Branch could get away with publicly speaking about what they felt was insufficient services, and to speak out about interference from the corporatist sector was very encouraging.

Nevertheless, these outbreaks, these breakouts are just small incidents, indications that there is desperation on the inside among some people and that desperation breaks out among people who have a great deal of courage. I am not even judging the cases. That isn't even the point. The point is that there is a willingness to open the debate. Actually, there seems to be a desperateness to open the debate.

However, these people are still fighting against the norm. They are denying the inevitability of the corporate truth. So there is a movement. It is more than it was a few years ago. And at the same time, there is a contradictory movement going the other way, which suggests that more and more, things are happening, faster and faster, that we should be discussing. But that happens in civilizations. You usually get two or three movements at the same time going in contradictory directions. So you're having cracks opening up on the one hand, and on the other hand we're moving faster and faster into models that haven't been debated sufficiently for us to know whether they are acceptable or not, whether they are a good idea or not.

Dr. John Polanyi, Nobel Prize winner for chemistry in Toronto, is increasingly speaking out about the problems of science, saying that the public knowledge, the public good, is being reduced to the knowledge economy. He gets criticized for it, in his own university he is being criticized. But they can't quite punish him. It's hard to punish one of our few Nobel Prize winners. But I am sure there are lots of people who would if they could. But he has a lot of courage and he has a tough skin, so he is able to do it.

I talk about all of this because what I am trying to do is to show how difficult it is to talk about agriculture, the environment, agricultural methods in a common sense manner, which will be open for debate. Common sense, the way it is used in our society today, is really short term and self-interested. It's not real common sense at all. So it's really hard to explain to people that it's common sense to have a debate about new technologies. It's not fear, it's not being backward, it's not being romantic, it is simply carrying out our responsibilities as citizens.

It is about wanting to have a debate about something new, which might turn out to be fabulous, but you don't know because you haven't been allowed to have a debate on the subject. Until you have the debate on the subject why should you, in a democracy, as responsible individuals, say: "Great guys, go ahead with it?" If you do that, you are not assuming your responsibilities as solid, intelligent citizens using common sense. You are giving in to something that Plato aptly described: "all knowledge that is divorced from justice must be called cunning." One has to be very careful that knowledge is not divorced from justice. The world isn't perfect. We won't always get perfect justice. But you work towards that. Because if it's only knowledge, then it's only Machivellian, then it's only cunning, and you have no sense of what it will lead to.

Corporatist societies lead quite naturally to a narrow viewpoint for the reasons that I have been saying. They telescope our view of each miraculous breakthrough. These seem to be miraculous because we only see them in a very narrow, elongated way. We don't see anything around it, we don't see society; we don't see ourselves. We only see the breakthrough as if there were no human beings on the planet. So each breakthrough appears to be miraculous.

But if these breakthroughs, in agriculture for example, have been so miraculous, then why is it that agriculture, with its runoff, is more or less the leading cause of water pollution? Why is it there is a farm crisis everywhere if all these breakthroughs are so miraculous and are leading us towards a wonderful and bright future? Why is it that there is a crisis in agriculture? Why are the farms going bankrupt if there are dozens and dozens of miraculous breakthroughs, which are so wonderful for agriculture? Why are all the farms going bankrupt then? We can't have it both ways. Either these are fabulous breakthroughs or they are not.

But if they are fabulous, farms shouldn't be going bankrupt, we shouldn't have high levels of pollution and we shouldn't have a farm crisis if these things are doing such wonderful things for agriculture. One just has to follow the logic, unless I am missing something - that actually these fabulous breakthroughs for farming are suppose to lead to the collapse of farming. I don't follow the logic. If these breakthroughs are leading to lower costs, then it should facilitate smaller farms, not bigger farms. If the costs are lower, therefore, then it should be easier and easier for small farms to do well. Funny enough it isn't.

Which suggests something quite different is happening. The structure of what is happening isn't what is described to us. Why, if things are so wonderful, are the farms going bankrupt, on one hand, yet the agricultural supply corporations are doing so well? Why do farmers, all over the western world, feel so cut off from the societies, which they played such an important role in creating? Because what I described for Canada can be said for many societies. It could be said for Australia, or for Europe or for the United States. Part of the problem is that farmers, partly because they are desperate, are having difficulty standing back to look at their own situation in the larger picture.

They've done this in the past. They did it in 1905 to 1910. That is why I told the story. They have managed to take their distances, in the middle of a crisis, which is why they did it, and to see what the whole should look like. The farmers, and the rest of society, are so unable to take a step back that we can't even agree that there is a crisis today. As the farmers go bankrupt, we are arguing about whether there is a crisis. Which again is a sign of a peculiar separation from reality. Partly because we've been caught up in a very narrow view of what globalization is.

There is nothing wrong with globalization, but what kind of globalization are we talking about? There could be 25 or 30 sorts of globalization. Why do we talk about globalization, as if everyone understood it, and if there was only this one inevitable thing, in one form, in one shape, organized in one manner? I could sit down right here and write you out 25 ways of globalization, each one different from the other. But because of the corporatist, linear view, we can only see globalization as this extremely narrow thing, like the technological breakthroughs.

And that approach to globalization leads to a belief in the inevitable: in order to survive in the biggest marketplace that has ever existed, we have to have bigger and bigger corporations. Therefore, we have to have a lot of corporations getting together so there are bigger and bigger ones. Which is an interesting thought since we were supposed to be doing this in order to increase competition. On the contrary the whole thing leans towards less and less competition as we get fewer and fewer dominant large corporations.

But of course, globalization does not require larger and larger corporations. Managerialism requires larger and larger corporations. It's a managerial structural obsession, grabbing territory to manage. It has nothing to do with competition. That's why it reduces competition as opposed to increasing it. I would be much more in favor of a globalization that increased competition, which would mean protection for smaller corporations. I wouldn't be troubled with that. But it's doing it in a way that discourages smaller corporations - that is the problem.

It goes without saying that if you are going to encourage larger and larger bus companies and larger and larger airline companies, that you are going to encourage larger and larger farms as a kind of adjunct to this very narrow view of globalization. Opposed to this is a very sensible and interesting and imaginative view of globalization, which could be put forward very easily because there is nothing in globalization that requires larger and larger farms - nothing at all. Quite contrary, the natural outcome of globalization should be the strengthening of local production because you no longer need to go out and have large global structures, because things can move around in the world, and therefore, you can have smaller farms. You can talk about the particularity of agricultural production. I will come back to that in a second to explain it a bit more.

What this whole corporatist approach does is it prevents us from engaging in inclusive thinking, lateral thinking; it forces us into narrow linear thinking. It prevents us from building in economics questions, agricultural questions, and commodity questions. It prevents us from building in things like pollution costs, medical costs and clean water costs, which have to be paid for, but they are paid for outside of the economics of the narrow, narrow view. So they have to be paid for separately, and they are not included in the accounting. They should be included in the accounting in a common sense society.

If I were a solid, old-fashioned Conservative, I would insist on those costs being included in the cost and profit definition of the people engaged in the work. It is not at all about lengthening our argument to say that we need integrated, all-inclusive economics.

Now on the surface people say it is the responsibility of the financial interests, and they slip into a kind of pseudo-Marxist, late in the day argument about a free market place, etc. But I really believe that it is only that on the surface. I really believe that it has much more to do with corporatism and with the closed in nature of corporatism, and its ability to prevent us from thinking about the whole of society. I am much more likely to find somebody, who is an actual capitalist that I might disagree with on many subjects talking about inclusive economics than I am to find the president of a large managerial corporation talking about it. They will never talk about it. Where as, many independent businessmen would talk about it.

I think that is part of the explanation for some of our confusion, for example, our confusion between effectiveness and efficiency. Effectiveness being what a sensible, down to earth, integrated society expects versus a linear, rational, corporatist society which is obsessed with efficiency - very narrow, low-level shop floor characteristics - which doesn't have any thought in it, or any risk. And which is now being promoted as efficiency unto the highest level of power and admiration in our society.

That confusion between effectiveness and efficiency explains in a way in which we missed the fact that in the agricultural sector, our problem today is overproduction, brought on to a great extent by these miraculous breakthroughs. And that overproduction has slowly but surely over the last few decades driven prices down in western society, thereby forcing governments to prop up the prices with subsidies, which are never enough because there are ever more breakthroughs which keep pushing the prices down. Breakthroughs increase production, which keeps pushing the prices down, forcing the government to push them back up again with subsidies. The more milk you produce per cow in this country the more the agricultural crisis will be exacerbated. It will get worse the more production goes up, not better, because prices will be driven down.

And in doing this, in increasing production unnecessarily, we are not doing anything out of the goodness of our heart. We've solved our own problem, so to speak. We're not doing anything on the other hand for the developing world or Third World because most of these breakthroughs require a sophisticated, high tech system to apply them, and the last thing the developing world needs are high tech systems, which are difficult to apply. That isn't what is going to help them along the way. The Third World, the developing world, have problems that are quite different. They are not production problems either. Their problems have to do with distribution, land ownership, and it has to do with large slums around the cities. People have left basically solid but simple farming for slums in cities where they do not have even access to the products of the farms.

So the sophisticated breakthroughs in fact have created to a great extent the farming crisis in the western democracy. If we want to raise prices and solidify farming in western societies, what we have to do is reduce our high-tech investments. We don't actually need to put 32 chemical products on apples. I counted them. That is why I said 32. We no longer need to put 32 products on in order to produce enough apples for people to have apples in order not to go to the doctor. It's one of those funny circles that don't seem to work quite right. It seems we have come around the circle the long way. And I'm not suggesting or making an idealistic statement here that we should do away with all 32.

What I'm trying to do here tonight is to say that in a solid economic manner the right policy today would be to say, "if you want the right quantity of apples in an overproducing market, which of the 32 could we do away with first?" Okay, next one. You start slowly but surely reducing the quantity of add-ons, which reduces the cost to the farmer, but it also may reduce the quantity of apples being produced and thereby pushes up the price of the apples, and therefore, reduces the need to subsidize the apples. It is not that complicated.

If I can work it out, surely the Deputy Minister can work it out. At the end of the day, it may turn out that you still need 10 of the 32. I don't know the answer to that question. I'm not an expert. But you certainly don't need the 32. In a flooded marketplace where you have too many apples, the worst thing you can do, strategically speaking, is to produce an apple like everyone else, because there are too many apples.

So what you should do instead is to say: well, since there are too many apples and most of the apples are Granny Smiths, clearly the smart thing to do is go to the top 10% of the marketplace, because that's were there is room to break through. That's the hard end of the marketplace. On the soft end are all those soft, mushy apples at the bottom that don't taste of anything. So if I want to actually make money and save my farm, I go for the top 10%. How do I go for the top 10%? By reducing the 32 things I put on the apples. I differentiate myself. I become particular.

You can afford to become particular when there is an overproduction of goods. In fact, the smart people become particular in all areas. When there are too many socks that are all white and so long, the smart people do colors and make them that long. Because this is where the money is to be made. That's where the solid part of the marketplace is. The dumb people say we're going to make our short socks even cheaper, and they go bankrupt.

Because if you come from a marginal area, for example, 30 million people instead of 300 million people, you can never make your short socks or mushy apples cheaper than the people who have a population of 300 million. You can't do it, particularly if you're climate is a little more difficult. So I am just describing to you what seems to me to be a strategy, which would be smart if you believed in the marketplace and staying in business. Go for the top end of the marketplace.

I can tell you that the people who are going to do well in agriculture over the next quarter century, unless they are large, large corporations, and I'm not even sure about them in the long term, but the people who are going to do well are the people who are going to go for the top end of the market. And to come from a middle class country like Canada, where you have a ready-made buying public for the top end of the marketplace, you don't have to export to do it. It would be very foolish not to go for the part of the market that will please the local buying public.

We know that industrial agriculture leads gradually to monoculture. That's why I gave the example of the white sock. In Voltaire's Bastards I have a whole section of a chapter where I describe the sock business. I could have been describing the apple business or any agriculture business; basically the managerial, high industrial center always goes for monoculture - one kind of sock, different kinds of packaging.

And we know that monocultures have been exposed to epidemics. We don't even have to prove it. History has proven it to us again and again and again. I say that as a lead to avoid talking about hormones and genetically engineered products. Rather than talk about them I would rather ask a question.

And the question wouldn't be the question which is always asked, which is: "is there proof that hormones and genetically-modified goods are dangerous?" That's the classic question - quite a stupid question. Why should you have to answer that question? The real questions are: "Is there a need for these things? What is the need for the marketplace? Is there a requirement? Are we starving? Do we not have enough goods? Do we need more goods of this sort?"

The other question would be, "do these goods increase farmers' dependence on a cash economy? Do they increase a farmers' dependence on seed suppliers?" If they do, then that ought to be discussed. "Do they increase the loss of product particularity?" You could argue that in quite an interesting way. So at a time of overproduction, the worst way you could ask the question would be to say that we're going to do this unless you can prove that it is dangerous, because it is really avoiding the core questions and the core situation.

But then, industrial structures have always been very abstract, even in a very non-abstract area like agriculture. And these industrial distribution structures of agriculture have an astonishing tendency to cut citizens off from their local produce. This means they create and encourage the delusion of the cities in Canada, for example, that they don't live surrounded by land; that they live inside their cities, with no relationship to the land.

In Ontario, for example, which is quite an interesting, mixed production agricultural province which suffers from overproduction, and from a consolidation of buyers, and from an abstract distribution system, the result has been that local retailers of foods are less and less likely to buy local produce. The quality seems irrelevant. The structure is what matters, not the goods. If it were really a functioning marketplace, the goods would matter.

But the fact is, in the middle of the Ontario peach season, most of the stores are principally selling California peaches with no taste. Why are they doing it? They are doing it not because of any competition between goods in taste and quality. They're doing it because an abstract corporatist distribution system doesn't care what the content is. It says cheap peaches must be on the shelf. And the question is what's the most efficient not effective way of getting them there? The result is that slowly but surely Ontario is becoming a secondary supplier inside its own marketplace.

So the real question about innovation is not" is there proof of danger", which is a very old fashioned approach. A real question is "what is the rush?" A real question is "will it help the farm crisis?" The real question is "do we have the time without starving to death to carry out careful, long-term experiments?" I am convinced the answer is yes. We have lots of time to say "that is an astonishing breakthrough that you seem to have made in the production of milk. We're really, really interested in it. We congratulate you. Now, we will allow you to take 100 cows and for the next 10 to 20 years, carry out a local experiment on it. And if we become desperate in the next 10 to 20 years, we may change our minds, because we don't have enough milk. But at the moment we have so much milk we don't know what to do with it."

We have the time for those sorts of careful, responsible, citizen based experiments. And we have the time also, because we know through our own recent experience, that short-term experiments don't tell us all we need to know. We have a history of antibiotics to show us that we went too fast and made mistakes, and may, thereby lose the fabulous breakthrough that antibiotics provided. Our over-enthusiastic use of antibiotics on animals and people for everything under the sun has led to increasing amounts of mutations and immunity.

We know over slightly longer periods of time that we don't understand what happens with moving water around in order to water agricultural areas that don't have enough water. You only have to go to the Darling River Basin in Australia to see the salinization crisis which is going on in what was one of their richest agricultural areas. I read very recently in a University of Manitoba study that over half of the cultivated land in Manitoba has wild oats growing in it that is resistant to brand name group of weed killers. In other words, we didn't understand because we went too fast. We didn't understand the implications of what we were doing.

We have our brains and our common sense. We are in a position to think our way through this situation. One of the most astonishing examples of course was the war against malaria in the Far East and in other parts of Africa. Twenty years ago we declared war on malaria. Today, malaria is completely out of control in the world. Why? Because we didn't understand what would happen if we unleashed certain methods in a rather naive manner. And the fact that the mosquitoes mutated at a speed that we couldn't have imagined showed that we didn't really understand how nature works. We weren't careful enough. It has nothing to do with left wing or right wing, or for the market or against the market. It has to do with being responsible and careful as citizens.

We've already seen in the middle of the argument over genetically modified products, a product against corn borers turning out to be equally dangerous for monarch butterflies. Maybe people don't care about monarch butterflies but even if you don't care about them, it's very interesting to discover that we didn't understand the implications. And if we didn't understand the implications for the monarch butterflies, what else didn't we understand the implications for?

Maybe we have to take a bit of time, not to be against, but just to think and work our way through these things to make sure that we don't make some disastrous mistake. Remember when people say they are sure there is no problem that means they are terrified because certitude is a sign of fear. Smart people are never certain and people who are confident in themselves, and who therefore know they are capable of being afraid, never say they are sure.

So let me finish up by coming to a couple of very simple questions. Very simple questions which I raise because it's interesting in a democracy that there is actually an argument about whether genetically modified foods is good or bad, and you will note that I have not spoken against GMOs tonight. I've spoken against something else much more fundamental.

There is an argument whether genetically modified foods should be labeled. Why would there be an argument whether or not they should be labeled? The answer is, of course, if you label it the public will panic. You've heard this on a regular basis. To which I can only repl:, I thought we lived in a democracy. I thought that the basis of a democracy was that legitimacy lay with the citizens and that the reason democracy has succeeded over the last two centuries is because the collective unconscious is more intelligent than the consciousness of the king.

Our brilliant trick is that we have access to the intelligence of the citizenry and they don't. That's how we won, right? So why would we be afraid that the citizens would panic if we told them something? If we live in a democracy, isn't it a good thing to tell them as much as we can? In fact, aren't we the citizens? So I actually don't understand why there could be an argument over whether or not citizens should be informed about things. Surely what the public will do is work out what they want to do. That's their privilege. We're in a democracy. If they want to panic, they have the right to panic. Nobody has the right to say that they don't have the right to panic. If you say the citizens don't have the right to panic, you're saying you believe in dictatorship. You have to make up your mind about these things. It's not for the elite to decide what the public's reaction should be.

One last question: there are people who say in response to all sorts of things I've been saying tonight, that the public wants to go to Price Club, Wal-Mart, whatever. The public won't pay higher prices for more carefully produced, and more particular, and less industrial food. That's the basic argument. The underlying argument is that they won't pay for it. They want it cheaper, to which I would reply two things. The first is: who says it is going to be more expensive? I made my economic argument earlier. I think it would be about the same price. The price is artificially held up because of the overproduction. If you deal with that you will end up in approximately the same place. There might be a short period in the middle for adjustment, but I don't think that if one moves carefully in the direction of more sensible production, which probably means more natural production, that it is necessarily going to mean a rise in market prices. It will mean a rise in real prices, which are irrelevant to the consumer, because they have to do with subsidies.

The second part of my answer would be to suggest that the public won't pay higher prices, or rather that they are not interested in more particular goods, is a very out of date, old fashioned argument. Anyone who has been watching the citizenry over the last decade knows that the leading edge of consumption of food has been away from industrialized food and towards the more particular. The middle class in this country have already made up their mind that they don't want to eat pre-sliced white bread that lasts for a month. They've already made up their mind about that a long time ago. So a large percentage of the population, probably about a third of the population that can afford it, has already decided that it is willing to pay more money, and certainly the same amount of money, for better and higher quality produce. It's probable that most of the population is interested in doing that providing that the price is reasonable.

So all of this is really to say that I don't understand why the thing, which says it is the marketplace, is resisting what really is the marketplace. I don't understand what they are talking about because what they are suggesting as the inevitable package of the day is in fact an anti-market place position to say nothing of an anti-public good position. I think it is a control obsession of managerialism and it has built deep within it a lack of respect for self and therefore, a lack of respect for the rest of the population. I think that the people who believe it is not possible to put forward a more reasonable and a more sensible agriculture system are people who are frightened by the reality of a real marketplace led by a real functioning democracy. ✪

SPEAKER PROFILE

*Internationally acclaimed novelist and essayist, **John Ralston Saul** is the only Canadian included in the prestigious Utne Reader's 1995 list of the 100 leading thinkers and visionaries. This Who's Who of contemporary creativity includes Noam Chomsky and Vaclave Havel. Author of Reflections of a Siamese Twin, Voltaire's Bastard and The Doubter's Companion, John's wit, candor and political and cultural acumen make for a lively and controversial experience for the audience.*

John Ralston Saul holds a PhD from King's College in London, and his B.A. in political science history and economics, at McGill University. He has run a Paris based investment firm, worked as a Canadian oil executive, and written extensively about North Africa and Southeast Asia. His 1992 book "Voltaire's Bastards", described by the Financial Post as "a giant J'Acuse, aimed squarely at the modern power elite", has been a phenomenal bestseller.

In his 1995 Massey Lectures he argues that our society is only superficially based on the individual and democracy. Increasingly it is conformist and corporatist, a society in which legitimacy lies with specialist or interest groups and decisions are made through constant negotiations between these groups. The paradox of our situation is that reductionist knowledge has not made us conscious. Instead, we have sought refuge in a world of illusion where languag has cut us off from reality. Consequently, we have great difficulties solving the problems of the real world, although there is no lack of possible solutions.

THE CASE FOR SCIENCE AND TECHNOLOGY IN AGRICULTURE: FROM DESTRUCTION TO WISDOM

— CAROLYN RAFFENSPERGER —

SCIENCE AND ENVIRONMENTAL HEALTH NETWORK

It says in the book of Job, "*But ask now the beasts, and they shall teach thee; and the fowls of the air, and they shall tell thee: Or speak to the earth, and it shall teach thee: and the fishes of the sea shall declare unto thee.*" Job 12:7-8

Tonight I have been assigned the task of discussing science, technology and agriculture - what curious dinner conversation. Do science and technology have anything to do with wild rice, carrots, and chicken and hence anything to do with agriculture? Are science and technology the words that come to your mind when you think of food?

Let me circle around this topic by considering an unlikely concept not usually discussed in scientific circles - Holiness.

For years I have struggled with the question of what is holy ground? During my time working for an environmental organization I thought the answer was clear - it was wilderness. Holy ground was any land which had not been damaged by humans and from which humans were excluded. It was obvious to me that farm fields were desecrated - the opposite of holy. What I smelled and saw and tasted of the corn and soybean fields in Illinois was anything but holy. It was a violated landscape.

Some years later I married a farmer who lives on the Great Plains. Our farm now has 1000 acres of unplowed, native grasslands. In many ways we were married on the prairie and perhaps we are married to the prairie. These magnificent grasslands don't meet the legal definition of wilderness since we graze our cattle on them and gravel roads surround them.

Nevertheless they are sanctuary, sanctified places. So I asked again in this new context, "what is holy ground?" The answer my bridegroom gave was, a relationship makes a place holy. I have come to see our entire farm as holy because of the deeply connected set of relationships of bee, grass, soil microbes, durum, buckwheat, flax, frogs, white pelicans, hawks, and other wondrous things. But we too are part of those relationships which allow us to share in that holiness.

"Humans are tuned for relationship. The eyes, the skin, the tongue, ears, and nostrils – all are gates where our body receives the nourishment of otherness. For the

largest part of our species' existence, humans have negotiated relationships with every aspect of the sensuous surroundings...every aspect of the earthly sensuous could draw us into a relationship fed with curiosity and spiced with danger. Every sound was a voice; every scrape or blunder was a meeting--with Thunder, with Oak, with Dragonfly. And from all of these relationships our collective sensibilities were nourished" (David Abram, _The Spell of the Sensuous pg. Ix.).

The subject of scientific inquiry must be precisely the relationships that allow humankind and the other Beings to mutually nurture each other. The technologies we develop must honor these relationships. Why? Because otherwise we cannot continue to survive and flourish. Our lives depend not on technology but on the relationship of pollinator to pollinated, eater to eaten and the transformer to organic matter.

It is these relationships of communion rather than coercion which foster sustainable relationships. Perhaps the best illustration of this is a story about my friend David Kline, an Amish farmer in Ohio. He called me one day a few years ago and told me that he had petted an owl while walking in the woods near his house. I asked him what the owl had gotten out of it. David laughed but didn't have an answer to my absurd and irreverent question.

Later that same day, a Navaho friend of mine, a young medicine man, called. I asked him a question that was on my mind since I was living in Washington DC - "what is power?" My friend said that power was when you had the ability to speak with all the animals and they had a willingness to speak to you. This was power as communion. Then I knew what the owl had gotten out of it - communion with David.

This story has a direct bearing on science and technology for a sustainable agriculture. To make the link, I would like to pose two definitions of science. As you know there are many. The two I am currently using are: 1) science is a method for seeking pattern in the universe; and 2) science is a search for truth.

Too often truth is considered to be isolated facts unsullied by emotion, value and spirituality.

But David Abram makes this lovely point; truth is not static fact but a style of thinking that associates truth with a quality of relationship.

"*Ecologically considered, it is not primarily our verbal statements that are 'true' or 'false,' but rather the kind of relations that we sustain with the rest of nature. My friend David Kline lives out truthful relationships -- ecologically secure relations -- with the natural world on his farm.*

And so it is that a human community that lives in a mutually beneficial relation with the surrounding earth is a community...that lives in truth."

What a wondrous task for the scientist -- she has the obligation to help us live in this truthful relationship with the natural world with all that truthfulness implies- honesty, integrity, harmony, responsibility. This allows us to extend and transform the role of science from a disconnected, disjointed fact-collection skill into wisdom. Science must not hide behind a spurious notion of objectivity since the scientist's view of her societal and ecological obligations determine the results of her research. Scientists who witness first-hand the destructiveness of current technologies and at the same time experience awe at the beauty of the world, have a great opportunity to use wisdom as the taproot for their disciplines.

Tonight I would like to explore with you three overlapping spheres and outline their role in science as wisdom and then consider what agricultural technologies or tools might arise out of a science rooted in wisdom and relationship. The first community is the natural world. The second is humanity. The third is that of scientists.

Every one of us is a deeply embedded member of the natural world. Our most primal relationships are those with the shivering, grazing, flapping, waving, honking, mooing, listening and speaking Beings that we eat and that eat us. It might surprise you but some humans have gone without sex for a long time, but we can't go without a relationship with those who are our food.

Humans all over the globe enter into relationships characterized by agreements about how we treat each other and how we treat the natural world. Most cultures have harvest festivals, laws about natural resources, healing practices, prohibitions against antisocial behavior, and so on. Some people within almost every culture have special responsibilities to serve as mediators between the natural world and the human community. Shamans, scientists, farmers and doctors all have had skills in understanding and mediating this relationship. Doctors seek to understand the microbes that cause disease and heal the ill. Farmers have enlisted the life giving forces of soil, water and the libraries contained in seeds to provide food for humans and other species.

Some among us have a rare gift to mediate the relationship between humans and the rest of the natural world. To paraphrase Martin Buber, people with this gift help create a "we-thou" relationship rather than a "we-it" relationship with the Other Beings. But, as a culture, we have lost that profound sense of calling and the skills required to know and work with the powers of the natural world. I suspect western science has had a role in this loss.

Doctors now plug patients into machines and prescribe genetically modified drugs to pacify and cure the afflicted rather than use healing hands. And farmers now plant seeds which have been "engineered" asexually. They pour on poison, and hack at the earth with big machines rather than midwifing new life out of soil, seed and sow. Those in both medicine and agriculture are mediating the human community not with the natural world but with technology developed under the industrial paradigm.

What is wrong with such technology? The hallmarks of the industrial paradigm are that it is dependent on borrowed energy. It concentrates and externalizes its wastes in ways that local and planetary ecosystems cannot absorb. It is based on specialization that destroys the biodiversity, which is essential to all healthy ecosystems including, and perhaps especially, those that sustain agriculture.

Technology developed under the industrial paradigm is "untruthful" insofar as it disregards its own effects and destroys the harmony between humans and the rest of the planet. Technology has become synonymous with machines and their cousins, artificial processes and substances. In fact, the word "technology" has been corrupted through the industrial revolution. It has lost the connotation of "pertaining to art" embedded in its Latin root "technic."

Technology can be defined as the artful application of scientific truth.

Scientists have long formed a community. It is the basis for the rigor required by scientific inquiry as exemplified by the requirement for peer review to validate research. Michael Polanyi the philosopher of science has argued that "*Many of the procedures known collectively as the 'scientific method' are important only because they make possible communication among scientists*" (Scientific Community, pg. 12). Scientists have made major contributions to how we understand our world. The view of planet Earth from space fundamentally reoriented our notion of our place in the universe. Odum's ecological theory has helped to provide methods for protecting endangered species as well as giving a theoretical basis for sustainable agriculture.

Theo Colborn's work on endocrine disruption explains complex illnesses that do not conform to models of carcinogenicity or infectious agents.

But much of agricultural science and the scientific community has followed the industrial paradigm -- depending on borrowed energy and the specialization that destroys biodiversity, and creating wastes that cannot be absorbed.
Agricultural science and the technologies it has developed have undermined all three communities. The natural world is rapidly being destroyed by technologies such as pesticides, genetic engineering and the transportation system. We do not have a mutually beneficial relationship with the natural world. We are, therefore, living a lie by undermining the truth-fulness, the harmonious sustain-ability, of ecologically grounded relationships. Barry Lopez says, "*...to make up something...which can never be corroborated in the land, to knowingly set forth a false relationship, is to be lying, no longer telling a story*" (Crossing Open Ground, pg. 69).

The human community is increasingly threatened by the very technologized food that is supposed to nourish us. US citizens only spend 10% of their dollar on food. But they now spend just over 10% on health care. It is estimated by United States Department of Agriculture (USDA) that US citizens spend 250 billion dollars on diet related health care costs.

I suspect that those estimates under-represent diet-related problems such as endocrine disruption and food-borne illnesses.

And of course, patenting and intellectual property rights for those technologies stifle scientific debate by the secrecy involved in the legal machinations around research. Nowhere is this more evident than in medicine and agriculture. The very communication that glues together the scientific community has been largely eliminated by patenting before publishing scientific results.

How do we re-establish a mutually beneficial relationship with the natural world and how can science help?

I would offer five criteria for science that should help us develop actions and technologies that support these harmonious and beneficial relationships.

1) Research can help us understand why we consider some organisms pests and it can help us turn pests into allies rather than enemies. As a matter of fact, current scientific paradigms identify insects as "pests" and some plants as "weeds" -- both are value-laden words. In a science that promotes harmonious relationships we would ask what is the place for insects and how do we relate to them?

   There are many examples from our own farm as we seek to coexist with various Beings. Aphids appear when there is too much nitrogen. Ragweed also thrives in soils with a surplus of nutrients. Both aphids and ragweed are allies because they provide information. This information is a lot cheaper than Global Information Systems (GIS) and requires a relationship between the farmer and her land.

   I should confess that I've given up with our biggest "pest," wild mustard, and we just eat it. I guess you could call us beneficial people.

2) Actions and technologies need to preserve existing relationships between plants, pollinators, soil microbes and other Beings. We underestimate these relationships at our peril. For instance, one out of every three bites of food must be pollinated. But we use insecticides wholesale without regard to the relationship between plant and insect.

3) Actions and technologies must be aesthetically pleasing. Seed or animal breeding can yield plants and animals that are beautiful. Why is this important? The aesthetic sense is our own biological radar for harmony.

   Science itself can't determine aesthetics, so scientists need to work with an engaged public to determine what tastes, smells, looks and feels good. Think about the directions we have taken even with traditional breeding. Holsteins are getting to be grotesque in their proportions because we are only breeding them for milk production. Genetically engineered crops and animals are often grossly distorted and ugly. Traditionally bred seeds developed through chemical and radiation mutagens lack the elegance of, say, my black popcorn that I am breeding on our farm.

4) Actions and technologies establish nutrient loops (rather than flows) so that all Beings' waste nurtures and feeds other Beings. That is, they don't externalize waste and the associated costs. On our farm we have closed loop cycles. Cattle eat waste grain and the plant eat cattle waste.

5) Actions and technologies result in systems, which provide meaningful work for all Beings. Earthworms disappear when they don't have organic matter to digest just as highly processed foods and overly sweet foods deprive the bacteria in our gut of work. Humans are not exempt from this criterion. How does our emphasis on labor efficiency take away meaningful work from us?

So what does this mean for science? Two things will point science in the right direction. One is to establish a truly public interest research agenda. The other is to participate in a science-based regulatory structure, which employs the Precautionary Principle.

We need a public interest research agenda which is well funded and clearly directed. At present, the public in the US funds only 32% of research.

I assume the statistics are similar in Canada. But even these few dollars are often used to benefit a private company rather than fully dedicated to the public interest. For instance, the United States Department of Agriculture spent public money on the so-called Terminator Technology. This was a purely private interest. This means that most of research is, in fact, directed to keeping these nations economically competitive rather than ecologically cooperative. Money trumps ethics.

A Public Interest Research Agenda does four things. It responds to ecological issues; it addresses public rather than private need; it fosters cooperative relationships among scientists in many disciplines; and finally, it incorporates an aesthetic sensibility into the work.

All of research and new technologies - even those derived from a solidly grounded public interest research agenda - need some kind of check, something that acknowledges the complexity of the planet and provides a method for the public to say "no" and "yes" to new technologies. Unfortunately, both Canada and the US have gleefully used risk assessment to underestimate the harms from new technologies and say yes to everything. Risk assessment has been used as a tool of arrogance.

In contrast, the precautionary principle is functionally a principle of humility. It tells us that when we have scientific uncertainty and the likelihood of harm, then we need to act with precaution. The precautionary principle provides ethical decision-making criteria for dealing with scientific uncertainty. Current agricultural scientific regimes sweep scientific uncertainty under the table. By honoring the precautionary principle scientists have an extraordinary opportunity to drive innovation by finding ways of working in concert with nature rather than forcing nature.

It allows us to do research that is robust to uncertainty and favor actions that are reversible. That is, we can find options and opportunities that do not cause damage for generations and over the wide geographies. We do not need more DDT, dead monarchs or pfisteria in the water.

In conclusion, I began this talk with a story about my coming to the farm on the prairie and what I understood about Holyground. I have also had occasion to think about the opposite of holiness and to seek definitions of sin.

My husband Fred defines sin as "separation." You can see how sin as separation dovetails with the definition of holiness as a right relationship. Western science has aggressively promoted the notion that humans are separated from the rest of the natural world. It has been horribly destructive. It has been sinful.

If society chooses wisely for science and agriculture, the technologies that we create will be tools that enhance mutually beneficial relationships among scientists, other Beings and our human community. These tools will not be designed to beat out other organisms or countries in some unwinnable race to economic competitiveness. These tools will be useful for right livelihoods, conviviality, art, and nourishment. We will have a much greater possibility of living in a relationship with each other and all of creation in ways that do not separate us. These relationships will be holy, truthful and wise. And then maybe all of us, scientists, farmers and customers will do as David Kline does and count the wild hatchlings as part of our harvest.

Let me read this poem by Wendell Berry as my offering to you and then I will sit down.

The Mad Farmer, Flying the Flag of Rough Branch, Secedes from the Union

From the union of power and money,
from the union of power and secrecy,
from the union of government and science,
from the union of government and art,
from the union of science and money,
from the union of ambition and ignorance,
from the union of genius and war,
from the union of outer space and inner vacuity,
the Mad Farmer walks quietly away.

There is only one of him, but he goes.
He returns to the small country he calls home,
his own nation small enough to walk across.
He goes shadowy into the local woods,
and brightly into the local meadows
and croplands.
He goes to the care of neighbors,
he goes into the care of neighbors.
He goes to the potluck supper,
a dish from each house
for the hunger of every house.
He goes into the quiet of early mornings
of days when he is not going anywhere.
Calling his neighbors together into the sanctity
of their lives
separate and together
in the one life of their commonwealth and home,
in their own nation small enough for a story
or song to travel across in an hour, he cries:

Come all ye conservatives and liberals
who want to conserve the good things and be free,
come away from the merchants of big answers,
whose hands are metalled with power;
from the union of anywhere and everywhere
by the purchase of everything from everybody
at the lowest price
and the sale of anything to anybody at the
highest price;
from the union of work and debt, work
and despair;
from the wage-slavery of the helplessly
well-employed.
From the union of self-gratification and
self-annihilation,
secede into care for one another
and for the good gifts of Heaven and Earth.

Come into the life of the body, the one body
granted to you in all the history of time.
Come into the body's economy, its daily work,
and its replenishment at mealtimes and at night.
Come into the body's thanksgiving,
when it knows
and acknowledges itself a living soul.
Come into the dance of the community, joined
in a circle, hand in hand, the dance of the eternal
love of women and men for one another
and of neighbors and friends for one another.

Always disappearing, always returning,
calling his neighbors to return, to think again
of the care of flocks and herds, of gardens
and fields, of woodlots and forests and
the uncut groves,
calling them separately and together, calling
and calling,
he goes forever toward the long restful evening
and the croak of the night heron over the river
at dark.

Amen

I owe special thanks to Nancy Myers, Tom Tomas and Fred Kirschenmann for their extravagant help. Any folly is mine alone. ✪

SPEAKER PROFILE

Carolyn Raffensperger is the Executive Director of the Science and Environmental Health Network (SEHN), a consortium of environmental and public health groups dedicated to promoting the use of science for public health and the environment. In 1998 SEHN convened the Wingspread Conference on the Precautionary Principle in order to instigate worldwide strategies to take precautionary actions.

Raffensperger is co-editor of a new book on the Principle entitled 'Protecting Public Health and the Environment: Implementing the Precautionary Principle'.

A lawyer, Raffensperger also holds a Master's degree in anthropology and archaeology.

She directs SEHN from her home on a 3400 acre organic farm in North Dakota USA which she shares with her husband, Fred Kirschenmann.

KEEPING FAMILY FARMERS ON THE FARM SUSTAINABLE AGRICULTURE: NOT AN ALTERNATIVE BUT THE FUTURE[1]

— JIM HORNE —

PRESIDENT,
THE KERR CENTER FOR SUSTAINABLE AGRICULTURE, INC.
POTEAU, OK

Never before have so few fed so many for so little! This is the real story of today's agriculture. Farmers today have at their disposal the most awesome technology that human kind has ever seen. We live in an information age where farmers with computers can find answers about any facet of agriculture. For every production problem that a farmer might have, products are being developed. With biotechnology, designer foods can be produced for any audience you might name and for every income group of consumers. On top of that we are told that there is an untapped worldwide demand for our products. Just a few months ago the world population reached six billion. People are hungry and new agricultural land is scarce—a modern industrial agriculture such as is in place in the United States surely will benefit.

This is the situation as we begin the new millennium. With demand unlimited, good times must be just ahead. But, let's hold it for just a moment: something is wrong with this picture. Just who will experience the good times ahead? That's the question. Will this demand for food benefit family farmers? Or will it benefit the transnational agribusinesses that are gobbling up farms, charging us technology fees for their seed and milking all the profits out of the export markets, leaving the farmer at the bottom of the economic ladder.

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[1] Keynote Talk, Dec. 9, 2000. Conference: *Options in Agriculture: Exploring Sustainable Alternatives, "It Can Be Done!"*, Humboldt, Saskatchewan, Canada

You know and I know that, today, all is not well in farm country and rural America! It's getting to the point where farmers cannot even save their own seeds. Farmers and ranchers are under almost constant financial pressure. The carrot of unlimited markets is often dangled in front of our noses, but is that even true? Unfortunately, most of the world's population is impoverished to the point that they cannot buy our food. The question then becomes, "Who will help us survive in the face of the Goliaths that control our food system?"

To understand why we are at this point, we have to look at the forces at work that have led us down this road. We believe that next year will be better; the problem is, we have found it is not. Here is what has happened over the past 50 years.

Myths of Agriculture

Products On The Technology Treadmill Will Save Us

After WWII the Defense Department had quite an arsenal of chemicals left over from the war and there was a need to find productive uses for these chemicals. It was then that synthetic pesticides and fertilizer came into heavy use. The products were an instant success. Powerful chemicals were solving many insect and pest problems. Fertilizer made from cheap oil produced miraculous yields. (Unfortunately, as agribusiness started refining old products into new, input prices began to increase). Factories that built tanks were now building tractors and plows. Agriculture was on the move in the 50's.

In the early 60s, the so-called Green Revolution occurred. Scientists bred higher-yielding hybrids that were more profitable. The downside: they were bred to produce best when fertilized, so farmers found they had to fertilize more. Before long, producers found themselves on a technology treadmill that was hard to get off . More and more new products developed by universities and agribusiness were placed on the treadmill and touted by farm magazines — all guaranteed to solve more and more problems and to make you money!

The downside of this technology treadmill is that the prices we have received for our commodities haven't changed all that much, yet input prices have skyrocketed. The average price of wheat in the U. S. over the 1965-99 period was $2.12 per bushel. Today's price of $2.15 is virtually the same. If we look at the price of what we pay for fuel, fertilizer, trucks, tractors, and plows, then we begin to get the picture of what's not working. True, new technologies have helped us to increase yields and spread overhead costs, but they have made us wholly dependent on purchased inputs whose price have no relationship to the prices we receive.

For the individual farmer it makes sense to produce as many bushels as possible. But when we collectively do that, we only increase inventory and lower prices.

What is needed and what has been needed is research that generates farming systems and inputs that will make wheat work at today's market prices.

More Efficiency is Better

How much efficiency do we need, or perhaps I should say, how much can we stand? That's the question. Somehow we have lost our common sense about efficiency. Or perhaps we have the wrong notion about efficiency and how to measure its worth. I often get to hear university deans of agriculture speak. Within the first two minutes of any public appearance, you will hear about how efficient agriculture is. Today one farmer can feed 129 other people — that is efficiency and it used to make me so proud. But the story not told is that we had to displace one-half million farmers since 1980 to get to where we are now. (And among those that remain, many are impoverished. It is a national disgrace that many U. S. farmers receive, or are qualified to receive, food stamps). Isn't it ironic that such a situation exists?

Not only did we displace these family farmers from the land, but we displaced rural merchants and other support establishments from the communities. Churches aren't empty in rural communities because people don't believe in God — they are empty because we transported farmers right off their land and out of their communities. Now everyone wants to talk about rebuilding rural America, but I don't see any help to get young people back on the farm.

One can hardly be against efficiency in this country, but we need to remember that it's how we count it that really matters. Of the one-half million U. S. farmers that we lost since 1980, the primary cause was not that they were inefficient. For the most part, it was because farm prices were too low. It had very little to do with efficiency.

The bottom line in agriculture about efficiency is that when we increase efficiency in production, we often get more output. Too much output with too few markets, customers that can't pay, or unreliable markets only leads to lower prices. Thus efficiency can be counterproductive and can lead to the need for fewer farmers — not because they were not efficient — but because the market couldn't absorb the products at profitable prices.

Exports Will Save Us

When people say American agriculture must feed the world — which gives everyone a good, warm, feeling — what they often really mean is American agricultural exports are the key to solving or balancing trade deficits. The promise that exports hold the key to a prosperous agriculture is a vain promise.

Every Secretary of Agriculture I have known since I was a young lad on the farm has told us how exports would not only save us but would actually put money in our pockets. But have they? I recall as a young person listening to the radio and hearing announcements that Russia would import grain. Prices would skyrocket in financial markets, and then a few days later prices would fall drastically when the deal was canceled. For many farmers, it's tough to understand how this could be: how the price of something they produce as a staple commodity could be worth so much one day and so little the next.

Volatile prices hurt farmers several fold harder than the large grain and meat packing companies that win either on the cash market or through their hedged positions. These corporations have dozens of people working the markets full time while we are tending our fields. Market gyrations mean money for companies like Cargill and other large transnationals. For the many farmers that are uncomfortable with or lack sufficient volume to utilize marketing strategies, the market gyrations surrounding an export sale mostly have painful consequences.

A cynic might look at the situation and say that we in agriculture have reverted to the social Darwinist view of survival of the fittest — that you must become a market whiz or you don't deserve the right to farm.

I agree with Chuck Hassebrook, a University of Nebraska regent, who recently said "American farmers should not count on a future of unlimited markets and prosperity based on exports to nations with increased numbers of mouths to feed. Productivity growth continues to outpace people's capacity to buy food. The expectation that a growing middle class in the developing world creates huge markets for meat and feed grains is often oversold. Farmers have been sold that for decades and it has never materialized. In fact the industrial agriculture emphasis on maximum production — production to supply the export market — has created many problems that ultimately may impair our ability to have a productive sustainable agriculture in the 21st century."

In short, "Don't bet the farm or ranch on a booming export market."

Keeping Family Farmers on the Land: Challenges

Resistance to Country of Origin Labeling

Political forces in our USDA have fought and resisted country of origin labeling. It appears to me if you are against informing consumers about the food they eat, something is being hidden. Nutritional labels offer useful information to consumers.

Country of origin labels would help American farmers compete because:

1) They use less toxic pesticides in the production of food compared to some of our neighbors.

2) They treat labor more fairly — avoiding the sweat shop syndrome often associated with other less developed countries.

3) Farmers are better off if consumers know who produces their food; it builds trust. Those against labeling are those aligned with large agribusiness, food sector coalitions, politicians, and yes, even our USDA.

Farmers and consumers need to demand country of origin labeling and become partners on a number of other issues.

Corporate Agriculture and Anti-Competitive Forces

Most of our food systems are controlled by only a few corporations. Phillip Morris, the largest tobacco company in the world, stood before a Senate committee a few years ago and said, "We don't have any evidence or knowledge that cigarettes are addictive." This same company that lied about tobacco is also the country's largest food company. Would they lie again about our food?

There are, aside from this example, a number of other corporations that come to mind quickly -- Con-Agra, Tyson, Monsanto, Continental Grain, IBP-- and others that have a strangle hold on the prices we receive for our food.

Because of mergers, acquisitions, captive supplies, and unfair price reporting — the average family farm hardly has a prayer. As evidenced in some local farm group advertisements, farmers only gets a widow's mite for their share of the food dollar. The big bucks go to those firms that have hundreds of traders and knowledge to take advantage of late breaking news. Unfortunately, these other sectors don't pass profits down, they only pass their costs up. Agribusiness — not farmers — is why food costs are high.

Unfortunately, this trend of mergers is not peculiar to agriculture. It's happening in banking, health, insurance, and most other aspects of life in the United States.

We are not the first to be concerned about big business. One of the most admired figures in U.S. history had this to say:

> *"I see in the near future a crisis approaching that unnerves me and causes me to tremble for the safety of my country.... corporations have been enthroned and an era of corruption in high places will follow, and the money power of the country will endeavor to prolong its reign by working upon the prejudices of the people until all wealth is aggregated in the few hands and the Republic is destroyed."*
>
> — U. S. President Abraham Lincoln, Nov. 21, 1864
> (letter to Col. William F. Elkins)
> Ref: The Lincoln Encyclopedia, Archer H. Shaw
> (Macmillan, 1950, NY)

It would be an interesting experiment to require that when companies merged, their products could only bear the name of the parent company. We would then see visually in our grocery stores that the shelf space is controlled by only a few large companies.

Research

Since WWII, the research establishment in this country has changed. Once it was the champion of the family farm and worked hard to help him or her survive and prosper.

Today, a good portion of our state and federal research dollars are targeted toward technologies that clearly only benefit mega-operations or operations that are involved in corporate vertical integration or technologies that actually are useful and affordable by a few farmers.

I don't suggest that there is any thing sinister about many of our fine scientists or people working in the university system or USDA. However, I will say that the system of funding research is broke and needs fixing.

A good portion of the research being funded today is funded by agribusiness. Their goal is to use the public tax-based institution to do the work for them so they can develop a propriety product to sell to farmers. At one time we joked about survival in the university system being based on "publish or perish." Now the system is based on "patent and do not publish."

The question is: Who really benefits from technologies? and Is too much research capacity being devoted to therapeutic research instead of preventive research?

Certainly, to be successful the product must work, i.e. you must kill the pest if you want the pesticide to be profitable. However, instead of looking at ways to control pests that have minimal or few side effects, they simply develop new products that serve as band-aids on new problems created by the first product. One of the trademark examples is the resistance among fly tags on cattle, and in human health, the new antibiotic resistant strains of disease.

Other examples of misdirected efforts include funding for research that benefits only a few. Most of the research done since the Green Revolution has had the effect of reducing the number of family farmers. It's hard for a farmer to win when the research establishment continually turns out technology that $2.25 wheat can't pay for, and U. S. Department of Agriculture policies force the migration of hundreds of thousands of farmers.

We need public research that benefits family farmers and consumers. Let agribusiness do its own.

Why Sustainable Agriculture is the Future — Not Just an Alternative

Sustainable agriculture will be the agriculture of the future. The industrialized system is broken, and across the land meetings are being held that will usher in the Next Green Revolution. This revolution will be based on policies that support a healthy ecology, economic prosperity, and social equity and justice. Sustainable agriculture is based on *timeless, enduring, unchangeable principles*. These principles are quite different than the human-made assumptions of neoclassical economics that man's technological prowess is somehow superior to nature. The difference between the two is like the difference between bedrock and sand.

At the heart of sustainability, is the merger of three interlocking circles that serve as essential elements of sustainability and the supporting pillars of all life and human activity. To make agriculture sustainable, we must develop systems that are ecologically sound, socially just, and economically sound.

The failure of the industrialized system is imminent because it does not respect ecological principles and concepts. So what are they?

Ecological Reasons for Failure of Industrial Agriculture Systems

Industrial agriculture systems are:

1) Based on monoculture
2) Seeks to destroy all pests — ignores the effect on beneficials
3) Uses therapeutic approaches instead of preventive
4) Tends to narrow and reduce genetic diversity
5) Tries to conquer nature rather than work with nature
6) Prescription farming — centralized farming — one size fits all
7) Soil is viewed as an artificial medium
8) Industrial agriculture methods lead to resistant pathogens

In contrast a sustainable agriculture

1) Recognizes the intricate web of life and intricacies
2) Attempts to enhance natural resources instead of just slowing the rate of degradation
3) Treats soil as a finite resource that has to be rebuilt rather than just adding NPK
4) Recognizes the balance of nature and understands that intervention causes a ripple effect
5) Sustainable agriculture looks to nature for solutions and attempts to maximize the use of solar power and photosynthesis as the ultimate and sustainable power source
6) Recognizes and respects the limits of nature
7) Seeks to maintain genetic diversity
8) Values life of all species of plants and animals
9) Learns to work with nature's cycles instead of trying to control them with inputs
10) Designs cropping systems that maximize the use of beneficials and variations bred to fit local conditions

Social Justice and Equity

It has only been in recent years that farmers and agriculturists have recognized that other people are also interested in food issues. Today's consumers want to know how their food was produced. Con-sumers do not want their food produced under sweat shop conditions and do not want their food produced with heavy doses of chemicals, and/or with genetically modified seed. What are the unsustainable, unjust aspects of our current food system?

The current industrialized food system has:

- Oppressed workers — legal and illegal aliens in the large packing plants.
- Reduced farmers to nothing more than serfs on the land by controlling all sectors through vertical integration.
- Allowed large firms to dominate the markets, destroy competition, and set prices.

- Allowed our public institutions and research facilities to be used for the primary purpose of producing proprietary patentable products rather than producing knowledge and cultural methods for farmers that will help to sustain them on the land. We can't be the R & D team for agribusiness.
- Caused us to spend public money on waste disposal for confined animal feeding operations — a responsibility of those companies that profit from the vertical integrated structure that shifts liability to the farmer.
- Emptied rural areas of their youth — loss of brain power by local infrastructure.
- Destroyed rural communities — those left behind are old and often have poor health care choices.
- Centralized agriculture in USDA and its corporate buddies.
- Resulted in an unprecedented number of agricultural bankruptcies.
- Left stewardship in the hands of corporate America — not comforting.
- Resulted in social injustice by:

    (a) Using food as a weapon or as a bargaining chip

    (b) Allowing for unequal power between parties negotiating contracts

    (c) Limiting future choices

    (d) Gleaning profits through exploitation

Sustainable agriculture offers a better alternative because it:

- Creates local communities through empowerment
- Builds value added industries allowing farmers to share in profits
- Welcomes diversity
- Worries about intergenerational equity
- Make sure that Local profits stay in the local community
- Strives for maximum local ownership — local control
- Uses polyculture, rotations, and legumes
- Reduces energy use
- Ensures social justice
- Is holistic

Sustainability will win ultimately. But those who are working for a sustainable agriculture face many challenges. As older, experienced farmers retire or die, who will take their place? Larger farmers and corporations are most likely the heirs as there are not many young people entering agriculture. We need programs for new entrants.

As we lose farmers, we lose communities, and we lose stewardship of natural resources. The general public is not sufficiently aware of these losses. In this country, cheap, plentiful food on the shelf is taken for granted. With only two percent of the labor force engaged in farming, most Americans have lost their connection to the land. When the cost of food is just ten to twelve percent of disposable income, it is easy to forget the difficult challenges of the farming profession.

The loss of farmers, rural communities, and natural resources has ramifications beyond rural America. If we lose our diversified system of food production, based on a healthy number of independent, family-operated farms, our national food security is at risk. As large corporations go about their business of patenting the world's food supply, tying farmers to their products of seed, pesticides, and fertilizers, and then serving as the only feasible market, we will witness further degradation of our natural resources, rural infrastructure, and the cultural history of farming in many communities. Can we trust corporations that have as their bottom line maximizing shareholder value, to protect our long-run ability to meet the needs of future generations?

Jim Horne
(photo by Darryl Amey)

As an economist, I understand the conventional notions and arguments that are based on the efficiency model, as well as its merits. However, as a person, I have come to care about many of the intangibles of life that are ultimately more important. Efficiency models do not take into account issues of topsoil loss, degradation of water quality, the human health consequences of industrial agriculture, issues of justice, distribution of income, hunger, or the value of a community. When any model of agriculture negatively impacts any of these, there is a cost. That cost may be easily counted or it may be as subtle as the barn depreciating. At some point, we all will pay.

The farm crisis is real and it has real costs that will be borne by this and future generations. If we want agriculture to sustain us, then we must make sure that our system is based on fairness and adequate returns for those tending the land. It must be based on sound ecological principles that will ensure that our natural resources are adequate to meet the needs of future generations. We are at a turning point. If we address these elements of sustainability, then we will see a resilient, decentralized food system that will meet our needs long into the future. ✪

SPEAKER PROFILE

Dr. James (Jim) Horne earned a Bachelor of Science degree in Agricultural Education at Oklahoma State University in 1969. He later obtained Master of Science and PhD degrees in Agricultural Economics. In 1972, he joined the Kerr Foundation as a consulting agricultural economist.

Dr. Horne serves now as President and Chief Executive Officer of the Kerr Center for Sustainable Agriculture. He has guided the organization in developing a program of sustainable agriculture research and demonstrations. This program is based on concept that ensure a viable agriculture without degradation of natural resources. These concepts, demonstrations, and applied research are in use at the Kerr Center's 4,000 acre stewardship ranch near Poteau, Oklahoma. The other major programs of the Center include a farmer grant program, and a public policy analysis program.

Dr. Horne has served as chairman of the Southern Region Council for the U. S. Department of Agriculture's Sustainable Agriculture Research and Education (SARE) Program; as a member of the Scoping Task Force on Sustainable Agriculture for the President's Council on Sustainable Development; and as chairman of the U.S.D.A.'s National Sustainable Agriculture Advisory Council.

THE DILEMMA OF BIOTECHNOLOGY

— MICHELLE BRILL-EDWARDS —

The following is a presentation by Dr. Michelle Brill-Edwards to the Biotechnology Workshop July 28th and 29th, 1998 in Ottawa, which I helped to organize. We have included it in this collection of articles because it is still very timely and fits well with some of the other presentations.

Dr. Brill-Edwards first hand experience in Canada's supreme authority on public health protection gives us some insights into how potential risks in approval of new drugs and foods chemicals are assessed. Her assessment of the situation of the regulatory system is a chilling one and gives support to the notion that we cannot be too cautious in accepting new technologies.

She is one of those rare, brave people who have defied what John Ralston Saul said: "What I am saying is that an employment contract can mean that you are punished if you speak out in a manner that is other than in accordance with the corporation. Even being slightly original will probably damage your career. Openness will be punished in our society. Helping the debate will be punished in our society."

We had this experience when we published our first set of proceedings of the 1998 conference "Exploring Organic Alternatives". We worked with the University of Saskatchewan Extension Division on this project, and were told that Dr. Brill-Edwards' paper could not be published "because it would put the university at risk to be sued."

This presentation encourages us to ask questions about food safety and how well we are really protected by the authorities, which have the mandate to protect our health.

— Hart Haidn, Saskatoon May 2001

I feel somewhat today like a fish out of water. The closest I have come to farming is that I'm a rather hapless gardener each summer.

But in a sense it is an education for me, with my background in drug development and drug regulations, to be hearing that so many of the issues that affect the regulation of drugs also affect the regulation of food biotechnology.

My intention is not to provide detailed information about the risks or benefits of biotechnology, but to provide a context. The dilemmas you face with biotechnology are being encoun-tered in regulatory changes around the world; and these changes are not well appreciated in the public domain.

In many ways, whether we are farmers, doctors, food specialists or whatever, we are operating in a regulatory climate that is changing so dramatically that we are always using a set of rules that are a decade out of date. However, we are always assuming that this set of rules is still properly operating.

In essence, the dilemma of how to deal with biotechnology is an age-old dilemma, an age-old controversy. Mankind has always sought to benefit from the goose that lays the golden egg. The promise of biotechnology is a modern version of that golden egg. We are trying to use a technology that has a great deal of promise, and we are trying to harvest that promise without at the same time harvesting the harm. However, the potential harm will inevitably occur.

The long-term effects of biotechnology are largely unknown and could be much greater than those of past advances and changes in technology. The possible harm may dwarf the potential promise. That is what has us so concerned.

As I sat here this morning, I was thinking: What is the role of the regulator? How do we come to that role?

A hundred years of experience and regulatory history tells us that there is a need for regulation in any society that hopes to benefit from technological advances. There is a need for a group of individuals with expertise to be paid full-time to study both the promises and the risks of any new advance. And we call this regulation. Regulation is legalized management of uncertainty, conducted in the public interest.

In my career, I dealt primarily with the Food and Drugs Act. The introduction to that act has a very nice statement about its intent: The purpose of the Food and Drugs Act is "to protect the public," very simple.

The purpose is not to protect the industry, not to protect profit, not to protect any subset of society, but to protect the public at large.

Protection from what I ask? ". . .from health hazards and fraud in the sale and use of food, drugs, cosmetics and medical devices."

We, Canadian society, say we need regulators, people paid by the Canadian public to act in our interests. The purpose of regulators is not to thwart the development of new discoveries and new technologies but to help us as a society to harvest the promise without at the same time unnecessarily harvesting the potential harm.

Where are we today with regulations? After 20 years of a policy of deregulation, we are basically at a point in Canada, and in many other countries, where our regulators have lost the capacity to protect the public. They simply do not have the time, expertise and, most important, the political will to actually enforce the spirit of the laws that are on the books, let alone the letter of the law.

Why do I say this? What evidence is there that ditching the regulations, which in essence is not enforcing them, has caused any harm? We only have to look at Britain to see the complete devastation of an entire industry, the British beef industry, basically due to deregulation decisions in the 1970s era of Margaret Thatcher.

Remember the political credo of the Thatcher and Reagan era? Deregulation and privatization began to flourish in the 1970s, resulting in the decision to allow feeding sheep brains to cattle. We saw the transfer of an infectious agent from species to species, sheep to cows, and now more recently from cows to humans. And we are looking not just at the devastation of the entire beef industry, but recently the blood industry as well. Canada, as well as Britain, has been caught in this devastation.

It was announced earlier this year [March 1998] that plasma (the liquid portion of blood) collected from citizens of the U.K. will no longer be used in production of blood products due to the risk of transmitting the infectious agent that caused mad cow disease.

At that time, it was a precautionary measure, but in June 1998 one of the American scientists who is vital to this debate presented data showing we have good evidence that CJD (the agent behind the human form of mad cow disease) is transmittable through blood and plasma.

Do we have any evidence that deregulation is a problem in Canada? We have only to look at the blood scandal to see that deregulation has been equally devastating here. There are many other examples, but blood is perhaps the most public and the best documented because of the Krever inquiry.

What does justice Krever say about deregulation? He is very clear. He says very bluntly (p. 1000) that the blood industry in Canada was the only industry that was not regulated throughout the period of most of the contamination. This is a pretty serious statement. What about his recommendations? Of nearly 50 regulations, fully one-third address beefing up the regulation of blood and other drugs in Canada.

So here we have one of the most important events of our generation in terms of health hazards being thoroughly investigated. The justice of record said in essence that this was a deregulation mega-disaster; just as mad cow disease was a mega-disaster for the British beef and blood industries.

Where are we going from here? Are we saying now, "Wait a second, this wasn't too bright. Maybe laws that insist that we observe the precautionary principle are wise laws. Perhaps we should go back to enforcing those laws properly."

No, we are not taking that approach. Oddly enough, we are taking the opposite approach. We are saying, "Don't look at the deregulation mega-disasters; those were the exceptions. Don't look at past mistakes. Let's move on."

What we're doing now is going into the final phase of deregulation. The first two phases occurred during the 1970s, 1980s and early 1990s.

Phase one was basically demoralization. The rhetoric is that safety is nothing more than red tape, getting in the way of the marketplace.

Phase two was de-professionalization. We basically stripped the regulatory agencies of the people with the expertise necessary to make independent judgments. Consequently, we now have agencies that are bereft of that kind of expertise.

Now regulatory agencies rely on outside committees of "stakeholders," most of whom are very badly compromised by conflict of interest, by ties to other people or institutions with vested interests in decisions. In other words, decisions are not being made independently by people paid to work in the public interest. Decisions are coming from others who have direct ties to private interests.

The final phase of deregulation is the dismantling of the regulatory agencies. I realize that your interest would be as much in the Department of Agriculture and the Department of the Environment, but I will give you an example from the Department of Health.

The Health Protection Branch is the agency that is supposed to oversee the safety of food and drugs. We are now witnessing the complete dismantling of the agency. Think of the Health Protection Branch as a four-leaf clover with one leaf the drug directorate, another the foods directorate, a third the disease surveillance unit and the fourth the environmental health directorate or the air and water safety unit.

Then ask yourself what's happening. What are we doing with that four-leaf clover?

The first leaf, the drug directorate, is being sent off, spun off as a special operating agency. Accountable to whom? We do not know. It will be run by committees. There will be decisions made by committees of experts, all of whom have ties to the pharmaceutical industry.

The next leaf, the food leaf, the leaf that you are perhaps most interested in, has already had a portion of it torn off and sent over to Agriculture Canada.

Now, why would you put a food inspection agency in the same department with a minister who has a mandate to promote the food industry? How can you send health inspectors who are supposed to take measures that may shut down a plant if they find hazards to human health, and have them report to a boss whose main concern is keeping that plant's economy healthy?

So you have a scenario where you are actually taking what should be in the public interest and sending it to another part of government where the public interest gets lost.

For the remaining bit of that food leaf, consider the research labs. Last summer [1997], quietly and with no public announcement, the minister and senior officers of the department decided to shut down that entire set of research labs. The food and drug research labs were going to be dismantled quietly.

These labs are a legally mandated operation, legally mandated through the enabling legislation required for the proper enforcement of the Food and Drugs Act. But Parliament was not going to be consulted. Nobody was going to know about it. We were just going to shut down the whole unit.

Well, citizens did not stand for it. People brought that message out to the public. The public reacted, and the minister got caught. He had to announce by September a moratorium. He could not face the public wrath.

What is the minister doing now instead? Has he reinstated the labs? No, the drug labs are gone. Even the glassware was smashed so it could not even be rebuilt.

Some of the food labs are still there. Some are not. But the remaining ones are in limbo because there is no budget there for them. Now the minister has announced that the branch will consult with the public to see if we need these labs.

The consultation period is deemed to be roughly about two years. In essence, what the minister could not achieve quickly last summer without public involvement, he is now going to achieve by time delays, by letting the unit die on the vine publicly.

Just to complete the picture, the surveillance units are being sent off to Winnipeg, where they will be totally dissociated from the other regulatory units.

No one is too sure what will happen to the environmental health group. They may go back over to the Department of the Environment, where, again, human safety is not the primary concern. So, in essence, we have a dismantling of the regulatory systems for food and drug safety in Canada.

And what will we do then? Then we will harmonize. What does harmonizing mean?

If harmonizing meant that we as Canadians would upgrade our standards for food and drug safety to higher international standards, then I think we would say, "Gee, that's a good idea."

But, in fact, if you are part of this community of drug development or food development and regulation, you know full well that harmonization is a method of downgrading regulatory standards around the world to the lowest common denominator.

Krever said it very well in recommendation number 44 of the inquiry. He said by all means harmonize, but only on those issues where you are going to be raising Canadian standards. Do not ever harmonize if it means lowering the standards that Canadians expect. He was very clear about that.

He was also very clear about sovereignty. Do not relinquish your right to establish independent standards of safety for blood. And I'm sure you could even broaden it to food and drugs.

Do not relinquish your right to establish standards that Canadians believe are acceptable. Do not be pushed into allowing lower standards because of trade agreements and harmonization efforts. The rhetoric that permitted the blood scandal and the BSE scandal was primarily focused on a term called "voluntary compliance." In other words, trust industry.

I think that what we have to ask ourselves is, "Why should we trust industry? Why should we go along with the total dismantling of the regulatory system, when there is no honest broker?"

To trust industry as a regulatory authority, we need to be able to go behind the closed doors of industry, examine the data, look at the research results, ask the public questions, and be able to demand specific information, like the results of long-term studies. However, in this post-regulatory climate, when corporations will not show us their data, why would we trust them?

Now, that brings us to the new climate, to the new regulatory system. What are the hallmarks of this new system? Well, the first hallmark is the promotion of voluntary compliance. We do not need regulators to go around and check what corporations are doing. We will just trust them.

Well, that clearly has not been working. The characteristic hallmark is the new rhetoric of proof of harm. The Food and Drugs Act, and most of the other regulatory legislation, requires that the onus is on the seller of a product, the manufacturer of a product, to produce the evidence of safety.

However, we have now just turned the whole apple cart upside down. You hear the rhetoric that there is no proof of harm. So now we can have products on the market until there is unequivocal proof that they are actually harmful and causing damage. And only then are we going to take them off. That is a whole new standard. A whole degradation of standards has just slipped in quietly in the last five to ten years.

Another hallmark of the current system is corporate sovereignty. Corporations have almost more rights under new trade legislation than nations, and certainly more rights than people do in many ways.

And we are asking ourselves many times, "Is it not the case now in Canada, and in most developed nations, that return on investment, that is the pursuit of the corporations, actually takes precedence over the rule of law?" I think the MMT is a good example of this.

Suddenly we cannot decide as a nation if we can keep this product out of Canada. But we can decide that there is a multilateral trade agreement that requires us to pay homage to the corporate right of the manufacturer. That is certainly the best reason showing the rise in power of the rights of corporations versus the rights of nations, and certainly private citizens.

Perhaps for me the most worrisome hallmark of this new post-regulatory climate is what we have come to call the culture of deception. This pervasive culture of deception is, in other words, a government climate that not only is permissive of deliberate lying but that actually encourages and rewards lying and deception, for the purpose of achieving a government will that is just the corporate will in disguise.

As an example, I mentioned the closure of the food lab last summer. What I did not tell you is that, at the time the announcement came, internally 77 scientists from the food research lab collectively signed a petition and presented it personally to the minister of health. In the petition, the scientists described very carefully, and in a very responsible, well-documented way, that Canadian lives would be jeopardized if this decision persisted.

The minister ignored this petition, and did not meet with the scientists. He instructed his assistant deputy minister to tell them to get back to work, and that any kind of resistance from within would not work, would not be successful, and would not be listened to.

In the meantime, the Canadian public was kept in the dark. No one knew this was going on. When asked about these things, the officers in the department said nothing was happening.

We later went through the Access to Information Act to get some of the memos and documentation pertaining to this decision. We found in fact that senior officials of the department knew the decisions they were taking would jeopardize the health of Canadians. You cannot just cancel the Scotland Yard for food hazards in Canada and expect that it will not cost some lives.

They knew it, wrote about it, and even wrote that they would not want the public to know this. So there would be no information alert to parliamentarians. And, to boot, they had media plans that advised that, if anyone found out about the closure of the food lab and the media started asking questions, the branch was to deny that there was a problem.

I am not kidding. A written brief, stated that, if the media asked, "Will the closure of the food research lab jeopardize Canadian lives?" the answer would be "No."

So what you have here is a deliberateness of deception and indifference to harm that is astounding, incomprehensible, to the average Canadian.

I come back to what I was mentioning at the beginning. We are experiencing the rapid decline of regulatory duty in Canada and elsewhere without even understanding it. The safety systems are being turned off.

It is like having an alarm system to your house disconnected. But you do not know it and every night you think it is still on.

What are citizens to do when ministers of the Crown deliberately do not enforce laws that are intended to protect the public, laws, which the ministers have a statutory duty to enforce? The ministers then turn around and tell the public, "No, nothing's different, nothing's changed," and then, when they are found out publicly, they just simply announce publicly, "Oh well, we'll call a moratorium on that decision."

What I am trying to get across is that we are now entering a phase of scientific exploration and development that is astounding in its possible scope for benefit. But it is equally astounding in its possible scope for harm.

What do we do about this? How do we conduct ourselves in this kind of climate? First, we need to start to question. We do not go to sleep. We do not say that somebody else will take care of this. We start to question because we know we are dealing with a culture of deception. Our group has actually described this culture in a fairly succinct way.

We call this culture of deception the "four D's." Know that you are dealing with a culture that relies on four responses to any opposition.

The first D is deny. Just say the problem does not exist and just keep saying it is not a problem.

When that wears thin, the next D is delay. Once you have to acknowledge the problem is there, form a committee, launch a legal challenge, call in the stakeholders, do whatever you want, but just delay the process of decision making and most folks will go back to sleep, thinking that the problem is being looked after.

The third D is divide. For those who do not go back to sleep, the opposition crowd, the activists, then use the tactics of division. Separate the softies who probably can be sweet-talked into accepting harm without realizing it.

And you are left with the rest of the group, the hardliners. They get the fourth D, which is discredit. Nettie Wiebe, former president of the National Farmers Union, was speaking about how the farmers who did not support biotechnology were discredited: "Oh, they must not know anything." It is a very common technique.

It happens to doctors, too. Any doctor who starts questioning a drug "must not know what he is talking about."

So the four D's are the hallmarks of this culture of deception. Know that this is what you are dealing with and do not accept bland statements. Do not accept that you have got to go on blind faith, without examining the data. Do not swallow what companies are selling.

The second thing we have to do is to take back the law. In other words, we have laws on the books that are not enforced. Those laws are our laws.

The Food and Drug Act is in essence a bill of safety rights for citizens. And we have just put it on a shelf. We have just pretended it is not there. All sorts of things are happening that would not be happening if laws were enforced, like the blood scandal. But no one is doing anything about it because citizens are not revolting. And I guess that is my message.

It is time for us as citizens to realize that the public service is not working in the interest of the citizens. Politicians in Canada are not working in the interest of the citizens. They are working in the interests of the forces who can benefit them most when they leave government.

Finally, I think that the most important thing is that we must not be solely reactive. We have to have our own agenda. In the case of biotechnology, it is neither good nor bad. It is not a question of do we stop or do we go. The questions we have to ask ourselves are: How do we proceed? How do we manage risk? How do we function in the fact of uncertainty?

I think we have to have a wide public dialogue here. And we have to establish our rights as citizens to have a say and not simply to be the sort of downstream recipient of corporate and government decisions that will benefit some but certainly not all.

As a result of biotechnology, there are a whole lot of people who are going to get rich. But it is not going to be the small citizens.

In the case of agricultural biotechnology, it is not going to be the farmers. In the case of drug biotechnology, it is not going to be the doctors. It is going to be the elite who are making decisions at large institutional levels.

We have to stop that. We have to have a public influence. We have to find vehicles for groups of citizens to make a difference. And I think that the meeting here is a really good start.

Question: How did deregulation result in the Mad Cow Disease crisis in the U.K.? Answer: There was a decision by the Thatcher government in terms of the source material allowed to be put into feed. Until the 1970s, sheep offal material was generally not considered to be part of the material that went into feed.

Deregulation changed that and the process of deregulation was a major influence in Britain during this period. The whole culture of secrecy, of access to information, is also part of the major problem in drug regulation.

I think that it is a serious blindness in public policy to ignore mistakes of the past. And the whole concept that we must not question industry, that we must accept risks and that basically anyone who speaks about a possibility for harm is really not with it and not scientifically acceptable, is not limited to inside the agency.

I can give many examples from the drug world of situations where public data show there is trouble with this approach. Of blindly following industry. But the interests of the industry are pervasive.

A 1998 article in the New England Journal of Medicine (Stelfox, Chua, O'Rourke, & Detsky) on conflict of interests looked at the attitude of doctors towards a controversial class of drugs. There were enough articles on these drugs in the public domain that the articles could be the subject of valid study.

In essence, the investigators did two things. They had the studies on these drugs reviewed independently by physicians who classified the studies as pro-drug, neutral or anti-drug in this particular controversy. The investigators then wrote to the physicians and asked a variety of questions. Among them were questions about their corporate support. The result was that 100% of the physicians who had written peer-reviewed articles in support of the drugs had financial links either to the producers of the drug or to their competitor companies.

The investigators next looked at the neutral group, the doctors who recognized the hazards of the drugs, but who did not have advice one way or the other. About 60% of the physicians in this group had received support from drug companies.

Next was the anti-drug group of physicians who, after looking at the same studies, concluded that there were safety problems with these drugs. In this group of physicians, only 40% had support from industry.

This study demonstrates that physicians have a bias deriving from their sources of support. Those who receive money from drug companies are more likely to interpret the same studies in favour of support of drugs.

The example is an important argument for why we need to have individuals with expertise who are paid from the public purse to think and to act in the public interest. We cannot assume proper protection of the public from bureaucrats with no particular expertise who make decisions on the basis of input from committees or individuals with links to industry.

Question: Should it be strictly a science-based regulatory system from your perspective, where we deal with safety and the probabilities of risks. Or do we take into account social issues and issues of cost, which opens a whole other can of worms? How do you see that regulatory system?

Answer: I think you have to stick with a sort of kernel of decision making that is based solely on health and safety. And then, downstream from that, you can add on considerations of costs of various kinds.

My concern is with the new drug regulatory scenario, and cost recovery. Once you start putting cost into the original assessment, the evaluations become so elastic and so difficult to manage that you do not know where to stand.

The one thing that people tend to forget when making health and safety decisions is that health and safety data may stay relatively the same. But the costs change over time. A decision that may be very costly today may be very inexpensive tomorrow and vice versa. To me, you always have to go back to the original evaluation of data based solely on what you would do if costs were not a factor, and then proceed from there. ✪

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SPEAKER PROFILE

Dr. Brill-Edwards is a physician and an authority on federal drug regulation and health hazards management of drug risks in the public interest.

She spent 15 years with Canada's health Protection Branch (HPB). From 1988 to 1992, she was senior physician responsible for the regulations of prescription drugs in Canada. From 1991 and 1992, she was also advisor to the World Health Organization Global Program on Aids Research.

Aware of repeated abuses (illegality) within the drug regulatory process, which were jeopardizing lives to bow to political and industry pressure, Dr. Brill-Edwards resigned from HPB in January of 1996. The public disclosure of the deficiencies of Canada's drug safety system at that time prompted her resignation and the formation of a new public interest group, which seeks to bring about honest answering from authorities on matters that affect the public in important ways.

Dr. Brill-Edwards was a founding member of this group, the Alliance for Public Accountability, which is leading a call for an investigation of Health Canada's abuses of our food and drug, and blood safety laws. Dr. Brill-Edwards is also in private speciality practice in Ottawa, providing patient centered health hazard management consultations on drug and blood risks for legal and health advocacy purposes.

THE FARM CRISIS: ROOT CAUSES

— BRIAN HALWEIL —

WORLDWATCH INSTITUTE, WASHINGTON, D.C.

The farm crisis is a global phenomenon. It is global in cause and global in consequence.

Farmers are threatened everywhere, on every continent, in every nation, in every countryside.

- A flood of cheap corn imports in recent years, following the signing of NAFTA, has driven down corn prices in Mexico, and driven millions of corn farmers into bankruptcy, forcing them into already over-crowded cities, where the situation for them is not much better.
- New Zealand Minister of Agriculture recently announced that 40 percent of New Zealand dairy farmers should be prepared to go under in the next 10 to 15 in order to make the nation more competitive in the global market.
- International trade officials are pressuring the Japanese to scale back their historic supports that have kept rural communities vibrant and farmer incomes among the highest in the world; the officials demand that Japan open its borders to imports of rice, even though consumers demand rice grown on Japanese soil, by Japanese farmers. Foreign-owned farms are popping up throughout the Japanese countryside as farmers begin to go under.
- In Poland, where family farms are vanishing, one puzzled hog farmer recently made a remark that speaks to every farmer on the planet. He said, "The price of pork keeps going down and the price of sausage keeps gong up. It doesn't make any sense."
- In Egypt, as increasingly scarce Nile River water gets diverted to urban and industrial needs, the share left for irrigation is squeezed. This is the story in much of North Africa and the Middle East, as well as other dry parts of the world such as the western United States, northern India, and northern China. Farmers face similar encroachment in land markets as urban and suburban areas swell.
- Near Washington, DC, where I live, the Delmarva Penninsula, which is the intersection of Delaware, Maryland and Virginia, is home to the greatest concentration of chicken farmers in the US, and perhaps in the world, but many of these farms, particularly the smaller ones, face bankruptcy due to declining poultry prices,

rising production costs, and competition from mega-farms; number of farms has been cut in half in last two decades, though production continues to grow and the Chesapeake bay continues to suffer under the waste burden.

In the press, we often hear farmers referred to as an "endangered species." Any conservation biologist knows that if we want to save an endangered species, we must first identify—and then remove—the threats to the species' survival. For most species, the common threats are habitat destruction, as when a river is dammed or a forest is cleared; bioinvasion, as when exotic species and introduced into a habitat and outcompete the natives; and chemical pollution, which may damage reproductive abilities or simply be lethal.

What are the forces that threaten farmers? Obviously, they are many, and they interact and synergize, and it's not always so easy to tease them apart, and they are surely not entirely new, though present developments may be extensions of old processes. I've identified three broad threats to farmers today, each of which reinforces the one before it.

The first threat we might call, Marginalization, and what I'm trying to capture in this term is a combination of changes in technology, changes in the way we farm, changes in the structure of agriculture, and the shifting powerplay between different entities in agriculture, which have been generally hostile to farmers and farm families.

The farmer currently commands a small and declining share of the food dollar. This is very clear when we look at specific food items, as well as across the range of food items. (See Chart 1.) For example, of every dollar spent on bread, just six cents goes back to the Great Plains farmer where the wheat was grown. The exceedingly small share is obvious for highly processed items, like corn flakes, but the farmer gets a relatively small share of the food dollar even for seemingly whole items, like eggs. And much of this change has occurred recently, the average American dairy farmer receives 32 cents of every dollar spent on milk, a large drop from the 52 cents they received in 1980. (I have to apologize for not having more local examples, but I have easiest access to American examples, and I think the United States has been at the leading edge of this anti-farmer processes, so American examples provide a good sense of things to come elsewhere.)

Part of the explanation can be found in changing lifestyles and eating habits. Widespread urbanization and the rise of dual-income households means less time for food preparation, which favors processed, ready-to-eat meals. Fewer people are eating whole, unprocessed foods. And as more of the population urbanizes, the connection between farmer and consumer is severed, creating more room for agribusiness to grab more of the food dollar with branding, marketing, packaging, and all those modifications of food that are refereed to as "value" added.

But we can also tie the declining share of the food dollar to changes in the way we farm; The entire progression of modern, industrial agriculture has been to move farming from a reliance on a few simple, mostly home-grown

Chart 1: Farm share of food dollar for selected foods, 1997

Eggs, Grade A large, 1 doz.	57 cents
Beef, Choice, 1 lb.	49
Pork, 1 lb.	35
Apples, Red Delicious, 1 lb.	21
Potatoes, 10 lbs.	17
Corn, can (17 oz.)	24
Applesauce, 25-oz. Jar	18
Potatoes, french fried, frozen, 1 lb.	11
Bread, 1 lb.	6
Corn flakes, 18-oz. Box	5

SOURCE: USDA

supplies to an absolute dependence on an extensive range of complex agricultural technology that has its origin away from the farm. And the post harvest side commands more and more control over the final product.

As a result, there has been a shift of economic activity away from the farm—the farmer—to nonfarm enterprises. Less and less of the value is added on the farm, while more and more is added in input and post-harvest stages.

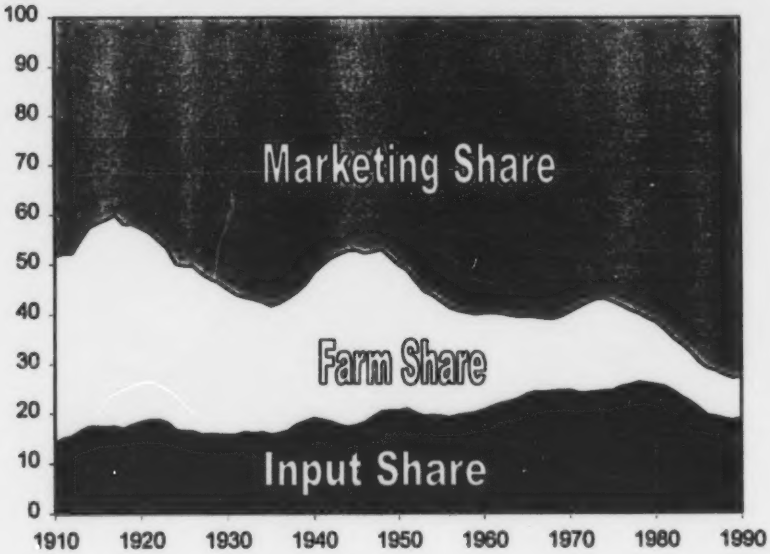
If we look at American food expenditures as a whole over the last century, it becomes even more clear where the food dollar is going. (See Figure 1.) The farmer's share of the dollar has dropped from nearly 40 percent in 1910 to under 10 percent in 1990, while the share going to input costs (machinery, ag chemicals, and seed) and marketing (processing, shipping, brokerage, and other post-harvest activities) has grown substantially. This figure was put together by Stewart Smith at the University of Maine, based on US Department of Agriculture data.

These shifts are obvious where tractors replaced animal power or pesticides replaced crop rotations and mechanical tillage, but they also include packaging and processing of crops once done on the farm that are now done off the farm.

And the latest agricultural innovations resonate closely with this pattern, substituting off-farm purchases for on-farm management and know-how, and leaving the farmer with less control over the production decisions and the final product. Precision agriculture technologies, for instance, will allow farms to be run from remote locations, further severing management from the local production system; and many of the biotech products that are in use, or currently in the pipeline, aim to seal management decisions within the seed itself, including which chemicals to apply, when to plant and when to harvest. Under these conditions, the farmer is reduced to a sort of modern-day serf, providing little more than labor and land to corporate agribusiness.

As the farm spends more and more on purchased inputs and off-farm services, its margin is squeezed. Net income as a share of gross income—what we think of as profit margin—has declined from 35 percent in 1950 to 9 percent today on the typical Iowa farm. What this means is that in order to generate the same income, an Iowa farm would need to be roughly four times as large today as in 1950. And this represents what is often called the technology treadmill: tighter margins require farmers to bring more acres under the plow, which often requires the purchase of additional technology designed to cope with the greater acreage (not to mention a simplification and specialization of the farm system to make it more manageable), which in turn means tighter margins, which requires more farm expansion. . . And all this while, all the farmers face tremendous pressure to maximize production (since they are increasingly concerned with quantity as opposed to quality,) and the tendency is towards oversupply, which suppresses commodity prices, which further exacerbates the margin problem.

Figure 1: Farmers' Declining Share of the Food Dollar, 1910-1990



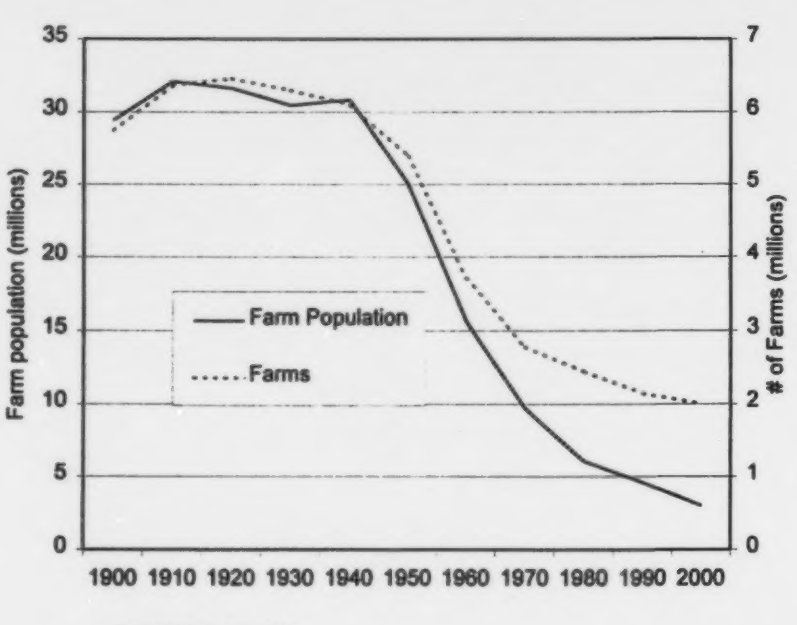
SOURCE: Stewart Smith, University of Maine

This treadmill yields a cycle of appropriation and cannibalism; that is, as more of the farm economy is appropriated by nonfarm entities, farms are forced to cannibalize their neighbors—or risk being cannibalized. And over the last century in the States, this is precisely what we've seen. (See Figure 2.) The number of farms has plummeted from six and a half million around the time of the first World War to two million today, though the acreage under cultivation remains near the historic high. At the same time, the farm population (those people who work on farms) has dropped even more dramatically—as people are phased out—from a peak of over 32 million people early in the century to just over 3 million today. In the United States, there are fewer farm operators than prison inmates. The average American farmer is 55 years old, not far from retirement, and agriculture has not become an attractive environment for farm-raised children, so the prisoner:farmer discrepancy will swell with our prison populations.

An additional result is tremendous concentration in the control over the land and the production assets. Just three percent of all farms in the US (these are the largest farms) are responsible for roughly half the national agricultural output; and the largest 20 percent of farms produce nearly 90 percent of the agricultural output. As farms scale up, they tend to be less connected to and dependent upon the local economy; they often obtain inputs and services from farther away; they may require markets that are farther away. As a result, money continues to leave the rural communities. And people who do not live on the land they work are less likely to care about it.

Not only has the nature of modern agricultural technology encouraged scaling up, it has also encouraged dependence—not to be confused with interdependence or mutual dependence. The folly of modern pest control provides perhaps the clearest example of this condition. Since around World War II, pest management has depended almost exclusively on the chemical pursuit of the insects, diseases, and weeds, an approach that demonstrates next to no understanding of the natural

Figure 2: Farm Population and Number of Farms in the United States, 1900-2000



SOURCE: USDA

processes occurring in the field. All agricultural pests have shown an uncanny ability to swiftly and surely develop resistance to any chemical we throw at them, and the result has been the so-called pesticide treadmill, characterized by excessive use of pesticides, leading to the development of pesticide resistance, necessitating the deployment of ever stronger doses or new pesticides, which in turn leads to additional resistance. (See Figure 2.) This pattern has been costly for the farmer, thoroughly counterproductive, and disastrous for the environment.

The second trend is an extension of the first and encompasses the on-going Consolidation in upstream (production input) and downstream (post-harvest) industries, which is happening at every point in food chain, from seed, agrochemicals, and farm machinery to processing, distribution, retailing, and farm finance.

Ever larger corporations means ever-expanding control over the functioning of the market. Ideally a market is made up of many small, independent buyers and sellers, none of which can individually influence prices and the market in any substantial way. However, a market with just a few, big buyers or sellers is very susceptible to manipulation for the benefit of those few, big buyers or sellers.

This consolidation represents a threat to farmers since the incentive structure and motives for agribusiness can be very different than that of the farmer. For example, for many of the downstream entities, such as processors, the crop is simply an input, the crop is a cost, so these entities would like to see commodity prices get lower; and handlers and traders don't care as much about cost as they do about volume, since they get paid based on how many bushels they put through. Even as farmers languish, these corporations are racking up record earnings: IBP, ADM, and Cargill have all reported near record years in 1998. (On a more basic level, a corporation is subservient to the profit motive and has very little room for other considerations, while family, pride, community, quality, stewardship, and any number of noncommercial considerations may be of greater interest to the farmer or the farm community than profit.)

There are two major forms of concentration. Horizontal concentration occurs within one level of the food chain, as when a major seed company buys up several other major seed companies, boosting the market share of the original company. Vertical integration occurs among levels of the food chain, as when a major seed company buys up a major agrochemical company or rural finance company, expanding the market control of the original company into other levels of the food chain. As the latest example of vertical integration in American agriculture, large fruit and vegetable processors are acquiring highly productive fruit and vegetable farms in the Central Valley of California to improve their control over the product stream.

Consolidation is not new, but like so many other economic and social and environmental trends, it is now happening on a much broader scale:

- A monopoly over the American railroads in the 1880s drove canals out of business, leaving Midwest farmers with just one option (and little bargaining room) for shipping their harvest. This ultimately inspired a number of anti-trust laws in US, but, unfortunately, the US government has been reluctant to enforce these laws since their inception, and one century later a similar consolidation of western railroads means similar oppression of western US farmers.

- Sixty percent of broiler production in the US is controlled by just 6 firms; the top 4 firms control 80 percent of the beef slaughter and packing in the US, up from 36 percent in 1980; in all sectors of livestock, we see a widening gap between the price received by the producer and the price paid by the consumer at the store.

- Turning to grain processing and distribution, just four firms control 60 percent of grain milling, and nearly 60 percent of port facilities, in the US; Cargill's recent acquisition of Continental means that Cargill controls more than 40 percent of all US corn exports, a third of all soybean exports, and 20 percent of wheat exports.

- The top 10 agrochemical corporations account for $26.2 billion or 85% of the $30.9 billion agrochemical market worldwide, with even higher concentration in particular regions and nations.

- Today, the top 10 seed companies control over 30 percent of the $23 billion commercial seed market, though but market share is much higher in specific crops and in certain regions. For example, the top 5 vegetable seed companies control 75% of the global vegetable seed market; just 4 companies (DuPont/Pioneer, Monsanto, Novartis, Dow) control 69 percent of the North American seed corn market; just 4 companies (Monsanto, Pioneer, Novartis, Dow) control nearly half of the commercial soybean seed market; at the end of 1998, Monsanto controlled 87 percent of the US cotton seed market, though it has since been encouraged by the US Department of Justice to divest some interests in cotton seeds in order to prevent an anti-trust suit.

- Agricultural biotechnology is now facilitating vertical integration by marrying the use of one corporate product to that of another, the prime example being transgenic varieties engineered to withstand a company's own proprietary herbicide.

The gradual replacement of open markets with monopoly, integrated ownership, and contract production does not bode well for the independent producer. The farmer is further squeezed from both sides, reducing the farmer's ability to bargain. The farmer is that much more vulnerable to being overcharged on the input side and underpaid after harvest, is least able to jockey for a greater portion of the food dollar, and becomes the easiest part of the food chain to squeeze.

The third and final process is the increased integration of local and national economies into the global market, the infamous process of Globalization. Globalization extends the two forces I just discussed to the global level.

Some of the most eloquent thinking on this issue come from Wendell Berry, a farmer and writer from Kentucky, so I'd like to read a passage from an essay Berry wrote in 1993, entitled, "A Bad Big Idea":

> *If the proposed revisions in the GATT [The General Agreement on Tariffs and Trade, which has now been replaced by the World Trade Organization] are adopted, every farmer in every member nation will be thrown into competition with every other farmer. With restrictions lowered to international minimums and with farmers under increasing pressure to make up in volume for drastically reduced unit prices, this will become a competition in land exploitation. Such conservation practices as are now in use (and they are already inadequate) will of necessity be abandoned; land rape and the use of toxic chemicals will increase, as will the exploitation of people. American farmers, who must continue to buy their expensive labor-replacing machines, fuel, and chemicals on markets entirely controlled by the suppliers, will be forced to market their products in competition with the cheapest hand labor of the poor countries. And the poor countries, needing to feed their own people, will see the food vacuumed off their plates by lucrative export markets. The supranational corporations, meanwhile, will be able to slide about at will over the face of the globe to wherever products can be bought cheapest and sold highest."*

For most crops, North American farmers are destined to not be the lowest cost producer, because of the higher real estate values, higher standard of living, higher costs of labor than are typical of many competing nations.

Even when they are, beneficiaries tend not to be farmer. For example, from 1980 to 1995, despite corn and wheat exports at 2 to 4 times 1970 levels, the dollar per acre return to corn and wheat farmers, excluding government payments, was negative each of those years. In other words, exports have been skyrocketing while incomes have stagnated or declined.

Once again the benefits of the export boom are going to pre- and post-farm entities; 70 percent of value added to corn grown in Iowa is added outside of Iowa. Remember that grain traders and shippers don't make their money on the value of the crop—just on the net volume that is passed through—so greater liberalization of markets, which will boost the volume of trade, is a very attractive prospect for them.

Currently there is a global grain glut, with few signs of abating. And as high-yielding agricultural technologies are adopted all over the world, there is the potential to expand production further in South America, particularly Argentina and Brazil, and in Eastern Europe, particularly in Poland and the Ukraine. These regions represent the growth markets for the Monsanto's and Cargill's and John Deere's of the world.

As all nations pursue policies to boost competitiveness in the face of globalization, the results can be unfortunate. For example, the world's two largest soy producers, the US and Brazil, are engaged in a parallel race to lower their export costs for soybeans. For the US, this means further development of the Mississippi River, and, in Brazil, this means developing a largely untouched river deep in the Brazilian rainforest, the Parana. Single-mindedly focused on grabbing a greater share of the soy market, both nations are ready to sacrifice their natural resources and extract additional revenue from the farm sectors. But, as is often the case, the big boys of agribusiness stand to benefit regardless of the outcome: ADM, Cargill, and ConAgra are the top three soy processors and shippers along both rivers.

Often, a justification for the emphasis on exports is the necessity to feed the world. This is a powerful and persuasive argument that transforms greater trade liberalization into a moral imperative. However, this argument, shows little understanding of reality.

Hunger is not about scarcity, but about access and empowerment. As Nobel Laureate Amartya Sen eloquently demonstrates, the availability of food is necessary, but not sufficient, to ensure food security. That is, people often go hungry even where and when there is food available. In fact, a report from the United Nations, released in October for World Food Day, showed that 80 percent of the world's hungry children live in nations that boast a food surplus. People go hungry because they are too poor to obtain food or the resources, such as land, seed, water, and credit, needed to produce it. Since the hungry are economically invisible, a world food market that responds solely to economic power will never meet their needs.

In fact, for poorer nations, where most people still derive a livelihood from the land, a greater flow of food trade often translates into greater suffering. On the island of Mindanao, in the Philippines, where farmers live and die by the price of corn, greater economic liberalization in recent years has meant a flood of corn imports, declining prices, social dislocation, and loss of livelihood—a pattern increasingly common in the developing world. Greater imports actually translated into fewer meals, and meals of less quality, as hundreds of thousands of people already living on the nutritional margin, have been driven deeper into poverty.

There is no doubt that nations throughout the world face various resource and policy barriers to boosting food production. Water scarcity in particular looms as a threat to future food security throughout Asia. And in much of Latin America, Africa, and Asia, the concentration of land in the hands of the few hampers broad-based poverty alleviation. But the international response to these barriers will be helping nations become as self-reliant in production as is reasonably possible, helping nations to harness and enhance the nourishing capacity already found within their borders and ecosystems and cultures, not by making them more dependent on a volatile world market. In particular, the social and ecological disruption caused in the wealthier nations by the modern agricultural paradigm should make poorer nations hesitant about following this path.

So where do we go from here? It's helpful to return to the endangered species analogy. To help an endangered species survive, we cannot just put it on the endangered species list or place a few remaining individuals in the zoo for safe keeping. These constitute band-aid solutions, which do not affect the underlying threats to the species—perhaps because it is thought that they are too great to alter—and concede that the species is destined to be a novelty only found in zoos and books. The only long-term option for ensuring that an endangered species flourishes is to remove the insults to its survival. In turn, to ensure the survival of farmers, the major challenge is to localize the food systems, to reduce the role of the middle man, and to return sovereignty to the farmer.

There are a range of options to help the farmer retain a greater share of the food dollar. The farmer can add more value on the farm, but modifying their input costs and doing more on-farm processing. The farmer can make greater use of co-operatives and farmer's markets which may shorten the distance between the farmer and consumer.

Organic farming presents itself as one option to boost profitability and retain more of food dollar, though organic is not completely immune to the threats of marginalization, consolidation, and globalization. (In fact, in the United States, consolidation in organics, especially in vegetable production is emerging as a threat to the integrity of the organic label and smaller organic farmers.) A study from the Wallace Institute for Alternative Agriculture in Maryland analyzed the profitability of organic corn and soybean production in the Midwestern United States. The study looked at three dozen organic farms, and each was far more profitable that the comparable conventional farm. This may not be surprising considering the price premium the organic farmers received. But what was surprising was that all but two of the organic farms were more profitable even without the price premium. The enhanced profitability came from much lower input costs, a more diverse crop mix making them less dependent on just corn and soy whose prices have been rock bottom, as well as greater resilience and stability in very dry, very hot, very wet, very diseased, or other stressful years. (And the greater profitability does not include the multiple other non-monetary benefits to the farmer, community, and environment, including less water and soil pollution, less risks to human health, and enhanced biological diversity.) Over the next few days, I'm sure we'll hear about more examples like these.

Organic farms are the most sophisticated and information intensive farm systems around, relying on an intimate understanding of those species interactions, nutrient cycles, and other ecological processes actually happening in the field, rather than on off-the-shelf techno-fixes which suppress the symptoms, but ignore the affliction. The greater need for management in organic farm systems returns sovereignty to the farmer.

To this day, the major consequence—unintended or not—of national agricultural policies has been to de-localize food systems, shifting benefits away from the farm and away from the community. The challenge is to eliminate policy biases, to revise agricultural policy in such a way that the local economy can retain some of the benefits.

Current farm payment structures which tie payments to acreage, for instance, encourage farms to scale up; fuel and chemical subsidies encourage large, chemical-dependent production systems; current lending and tax policies encourage capital accumulation and favor capital intensive operations; subsidized transportation routes encourage greater distance between farm and consumer.

Land-grant universities, agricultural colleges, extension services, and government agencies originally established to assist the small independent farmer and serve the public interest are increasingly under the control—both financial and political—of the private sector. Through patents and other proprietary agreements, corporations are extracting knowledge and innovations from the public domain. In such an environment, there is little incentive to develop technologies that help farmers to retain more of the food dollar, that make farmers less dependent on non-farm entities. In such a research structure, the focus will be on marketable "solutions" to farm problems—solutions focused on a chemical, a machine, or a gene that can be sold to the farm, rather than on a diverse rotation, more holistic farm design, or greater use of cover crop that can be taught to the farmer.

Governments will need to actively support the localization of food systems, through the promotion of farmer's markets, campaigns to increase consumer awareness of the benefits of local agriculture, and quotas for government institutions to buy a certain share of their food locally. Governments will also need to support the transition to farmer-friendly and environmentally-friendly farm systems, like organic production.

Justifying this sort of government action becomes obvious when we begin to broaden our definitions of the costs and benefits attributable to agriculture, and recognize many of the intangibles that come from healthy farmland and rural communities. We need to start thinking of farms as "multi-functional," not simply a production unit to crank out cheap food in mass quantity, but to produce quality food and quality social conditions. We know, for instance, that as farm size and absentee ownership increase, social conditions in the local community deteriorate and rates of depression, alcoholism, suicide, poverty, and inequality soar. Small, independent farmers tend to be better stewards of the land and have more incentive to preserve the health of the surroundings, since these surroundings are their home.

Over the next few days, we will hear about alternative agricultural systems, how profitable and productive they can be, and what policies are required to get us from here to there. Redirecting agriculture will not be easy. The current patterns are more than a century in the making, but we should take heart that simply acknowledging the need for change is often the most frightening and most difficult step. ✪

SPEAKER PROFILE

Brian Halweil is a Staff Researcher at the Worldwatch Institute. He came to the institute in 1997 as the John Gardner Public Service Fellow from Stanford University. At the Institute he researches issues related to food and agriculture, ranging from organic farming to biotechnology, from hunger to water scarcity.

Brian holds Bachelors of Science degrees in Earth Systems and Biology from Stanford University. He has also completed research, fieldwork and coursework at the College of Agricultural and Environmental Sciences at the University of California at Davis. His work at Davis included participation in the "100 Year Sustainability Project" as well as the Student Experimental Farm for Alternative Agriculture.

Brian has authored editorials and articles for Worldwatch, contributed to Vital Signs, and co-authored Worldwatch Paper 143, Beyond Malthus: 16 Dimensions of the Population Problem. He authored two recent Vital Signs Briefs: "On July 4th, US Leads Global Meat Stampede" and, with Lester Brown, "The Yangtze Floods: The Human Hand, Local and Global." His work has been featured in national newspapers, such as the L.A. Times, Christian Science Monitor, and New York Times, and on radio networks, such as NPR and Voice of America. Brian has spoken to groups at non-profit organizations and academic institutions on a variety of issues, ranging from organic farming to vegetarianism, from corporate ethics to environmental problems in China.

He has traveled extensively in Mexico, Central America and the Caribbean, learning indigenous farming techniques and promoting sustainable food production. His senior thesis focused on his work throughout Mexico and Cuba, promoting bio-intensive farming as a means to improve household food security and household income in rural areas.

THE FARM CRISIS, EU SUBSIDIES, AND AGRIBUSINESS MARKET POWER

— DARRIN QUALMAN —

EXECUTIVE SECRETARY, NATIONAL FARMERS UNION

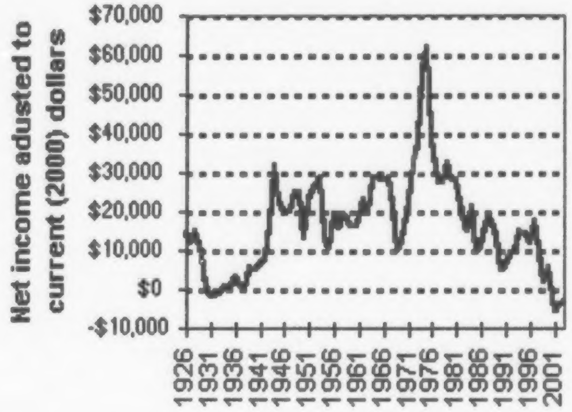
Executive Summary

The income crisis

Farm incomes have returned to Depression-era levels. Farmers' realized net incomes will be very low for 1999 and 2000 and negative for 2001, 2002, and 2003, with losses worse than those during the depression.[1] Saskatchewan presents the starkest picture of what grain, oilseed, and hog producers across Canada can expect over the coming years (see graph at right):

While Saskatchewan provides the starkest illustration, the crisis is not confined to that province. In nearly identical fashion, net farm income has fallen to 1930s levels for grain and hog producers in Alberta, Ontario, *and across Canada*.

Saskatchewan per-farm realized net income: 1926-2003



In the 1930s, it took a worldwide economic collapse, a stock market crash, mass unemployment, and a prairie-wide drought to drive net farm incomes to negative values.

Today, stock markets are booming, employment levels are fair, the weather is generally good, and crops are average or better. *The current farm income crisis is unprecedented in times of economic prosperity and stability.*

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[1] All sources and references provided in main brief.

EU subsidies

The unprecedented and dramatic net farm income collapse has Canadian federal and provincial ministers of agriculture scrambling to find an explanation. Most often, their explanation is that the crisis is caused by agricultural subsidies, primarily European. These politicians have pledged to work through trade negotiations to rid the world of subsidies and, thus, restore prosperity to Canadian farmers.

Those who blame the farm income crisis on European Union (EU) subsidies put forward the following analysis:

EU subsidies → increased EU production → over supply → depressed prices → farm income crisi

They point to significant increases in EU production as evidence for their analysis. But what if production is also increasing in countries that have very low subsidy levels? That is exactly what is happening.

Let's begin by looking at wheat production increases. Five major producers—Canada, the EU, U.S., Argentina, and Australia—accounted for 87% of world wheat exports in 1998/99. The table below lists trendline changes in wheat production for these five major exporters. It demonstrates that while production rose in the heavily subsidized EU countries, it rose at comparable rates in relatively unsubsidized countries such as Australia and Argentina and (at a lower rate) in Canada. In the next most highly subsidized country after the EU—the U.S.—production of wheat declined. If production is increasing in relatively unsubsidized countries at a rate similar to that of the highly subsidized EU countries, any causal link between subsidies and increased production is broken.

Wheat production: 1980-99

European Union	+42%
Australia	+44%
Argentina	+26%
Canada	+11%
United States	-7%

The absence of any relationship between subsidy levels and production rate increases is even more striking when one looks at coarse grains and oils. For coarse grains (barley, corn, sorghum, oats, millet, rye, and mixed grains), EU production over the last 20 years (1980-99) is up just 0.4%. Australia, Canada, and Argentina reported increases of 46%, 3%, and 9% respectively. In production of edible oils, EU production increased at 1/4 the rate it increased in Canada and Australia and 1/7 the rate of Argentinean increases. There seems to be no major grain or oilseed sector where production increase rates in the EU have significantly exceeded those in non-subsidized countries.

Clearly, the assertion that subsidies cause increased production must be augmented by the assertion that *the absence* of subsidies also causes increased production. Had EU subsidies been lower or non-existent over the past 20 years, there is little evidence that its current production would be lower, that world grain prices would be higher, or that the worldwide farm income crisis would be less severe.

The real cause of the income crisis

The purpose of the preceding analysis, developed in detail in this brief, is to refute the argument that European subsidies cause the current income crisis. Once accomplished, farmers hope that this will force elected leaders, trade officials, and other decision-makers to grapple with the real causes of the income crisis and with the real solutions.

The market is failing farmers, it is failing all around the world, and it has been since at least the late 1970s. The market is failing to return a fair and adequate share of the consumer dollar to farmers. And it is failing to allocate to farmers a reasonable return on labour, management, and equity from our agri-food system's huge revenue stream. Moreover, this market failure *is entirely predictable*. It is a direct result of dramatic market power imbalances between agri-food industry multinational corporations and the family farms that must do business with these firms.

Modern food production takes place in a chain which includes oil, fertilizer, seed, chemical, and machinery companies on the input side and grain companies, railways, packers, processors, retailers, and restaurants on the "downstream" side. Almost every link in this chain, nearly every sector, is dominated by between two and 10 multi-billion-dollar multinational corporations:

- Three companies retail and distribute the bulk of Canadian gasoline and diesel fuel;
- Three produce most of the nitrogen fertilizer;
- Nine companies make our pesticides;
- Four companies are gaining control of our seed market;
- Three produce most of our major farm machinery.

The situation is the same on the "downstream" side of the food production chain:

- Nine grain companies collect Canadian grain;
- Two railways haul it;
- Two companies dominate the beef packing sector and a handful dominate pork;
- Three large firms manufacture 87% of the pasta in Canada;Four corporations mill 80% of Canadian flour;

- Three companies manufacture the bulk of the soft drinks sold;
- Four companies produce most of the cereal;
- Five companies control food retailing in Canada;
- A handful of restaurant chains control an increasing portion of the restaurant business.

The single significant exception to the pattern of extreme concentration outlined above is the farm link. In Canada, that link is made up of over 270,000 relatively small family farms.

In addition to the small number of firms that dominate each link, their size stands out. Total 1998 Canadian gross farm revenues were $29 billion. Cargill's revenues were $75 billion that year. Philip Morris Inc. (Post, Kraft, Oscar Mayar, Kool-aid, Jello, Maxwell House, Marlboro, Miller) had revenues in 1998 of $109 billion. Nestlé (Stouffer's, Maggi, Libby's, Nescafé, Perrier, etc.) had revenues of $76 billion. While these revenues dominate the other links in the agri-food chain continue to earn large profits.

"Return on equity" is a common measure of profitability. It is calculated by dividing net income (profit) by average equity (assets minus debt). An accurate and startling picture of relative profitability emerges when one compares return on equity rates for farmers to those in the other links in the chain. While farmers earned just 0.3% return on equity in 1998, agribusiness corporations earned 5%, 20%, 50%, and even higher rates. This brief contains detailed data on the revenues, profits, and return on equity rates for most of the major agribusiness corporations operating in Canada.

are large in relation to total revenues for all Canadian farmers, they are staggering compared to the revenue of any individual farm family.

If one looks objectively—without preconceptions about the marvels of the market—at the agri-food chain, one would immediately have doubts that extremely numerous and relatively tiny family farms could extract fair and adequate revenues and profits from a chain dominated by firms a thousand to a million times larger. These doubts are borne out when one compares farmers' profit levels to those of agribusiness corporations. While farm families struggle with large losses, the huge corporations that

While the farmers growing cereal grains—wheat, oats, corn—earn negative returns and are pushed close to bankruptcy, the companies that make breakfast cereals reap huge profits. In 1998, cereal companies Kellogg's, Quaker Oats, and General Mills enjoyed return on equity rates of 56%, 165%, and 222% respectively. While a bushel of corn sold for less than $4, a bushel of corn flakes sold for $133. In 1998, the cereal companies were 186 to 740 times more profitable than the farms.

Maybe farmers are making too little because others are taking too much.

Consumers pay trillions for food. The prices they pay increase each year. The corporations that make, transport, package, process, and sell that food make billions in profits. The corporations that make tractors, fertilizer, and pesticides make billions. There is no shortage of money in the agri-food system; there is merely a maldistribution of money. The farm income crisis is caused by that maldistribution, not by EU subsidies.

If farmers earned just a 5% return on their equity, Canadian realized net farm income would be $9.3 billion in 1999 instead of the projected $2.8 billion. Even a 3% return would largely solve the problem. If farmers enjoyed returns on equity comparable to those enjoyed by other players, there would be no farm income crisis.

As evidence for the thesis that the farm income crisis is caused by an imbalance in market power and a subsequent mal-distribution of profits, this brief presents:

- an examination of pork packer profits during the recent hog price crisis;
- a brief analysis of fertilizer pricing practices;
- information on the farmers' declining share of the consumers' grocery store dollar; and
- comparisons of farm and corporate profitability for 1998 and over a five-year period.

The National Farmers Union is confident that those who read this brief will share our conclusion that the cause of the current farm income crisis is not foreign subsidies, but instead, market failure caused by enormous imbalances in market power. Once farmers, government officials, and other Canadian citizens understand this, we can then move forward toward solutions that safeguard family farms and rural communities. ✪

We hope that you have enjoyed this executive summary and will read this brief in full. It is available for by mail by calling (306) 652-9465.

SPEAKER PROFILE

Darrin Qualman has lived and farmed most of his life at Dundurn, Saskatchewan—just south of Saskatoon. While he discontinued large-scale farming in 1994, he and his wife Donna are currently making and selling hay for dairy cattle and horses. Darrin and Donna are considering organic field crop production.

Darrin studied Political Studies at the U of S. He worked on energy and environmental issues in the early 1990s and became the executive secretary of the National Farmers Union in June of 1996, a position he still holds.

The National Farmers Union works to support rural communities and to ensure that the family farm remains the principle unit of food production in Canada.

Darrin was the principal author of an influential report entitled: "The Farm Crisis, EU Subsidies, and Agri-Business Market Power."

RESISTING CHANGE:
CHALLENGES FOR PEOPLE AND ORGANIZATIONS

— HART HAIDN —

Comprehensive analysis of mainstream agriculture suggests that it is not sustainable. Research studies and the experience of farmers with alternative practices and systems demonstrate that more sustainable methods in production, processing and distribution are not only desirable but also possible. Most studies concerned with changes in agriculture do not consider the political, social and psychological factors, which block most changes.

External and internal conditions on the farm are constantly changing. As knowledge changes, farmers, communities and everybody involved in agriculture must be encouraged to change and adapt. The experience of the past twenty years has demonstrated that this is very difficult.

The number of successful applications of sustainable agriculture is growing world wide, and yet it is only a relative small number of farmers that have adopted new practices and have developed sustainable systems on their farms.

Why is it so difficult to implement the changes necessary to make agriculture more sustainable? Stuart Hill is convinced that "*One reason is that sustainable agriculture presents a deeper and more fundamental challenge than many researchers, extensionists and policy makers have yet supposed. Sustainable agriculture needs more than new technologies and practices.* "

In trying to find solutions it is helpful to be aware of the barriers to change. We heard in the past 20 years the call for changes in agriculture from many different directions, often the calls came from individuals or organization who themselves were not willing to change but saw the need to change for others. Usually the suggested changes meant a continuation of the current systems, just with more technology, monoculture, capital and management. Farmers were encouraged to tinker with the predominant systems of agriculture and discouraged to seek for more fundamental changes.

The following presentation is by no means a comprehensive study on the barriers to change in agriculture. It is merely meant to prick the interest in the subject and to encourage a closer look at an area of knowledge, which still receives not enough attention.

In 1985, Doris Lessing gave the CBC Massey Lectures under the title 'Prisons we Choose to Live Inside.' In this she made the point that our ancient heritage, psychological factors, social and economic pressures build walls around us, which are difficult to break down. Therefore we choose to live inside them.

In her lecture she described how people in the educated West see themselves: "*I am a citizen of a free society, and that means I am an individual, making individual choices. My mind is my own, my opinions are chosen by me, I am free to do as I will, and at the worst the pressures on me are economic, that is to say I may be too poor to do as I want.....People in the West therefore may go through their entire lives never thinking to analyze this very flattering picture, and as a result are helpless against all kinds of pressures on them to conform in many kinds of ways*".

We all are products of our heritage and environment. The way we have been trained and educated has a major influence on how we behave. It is often difficult to break out of a pattern of behaviour, which we have developed over time. And it is difficult to accept that we have been educated in a way of farming that has created the problems agriculture is facing now. It is painful to realize that we have been part of the problem.

It is normal for people – and organizations – to resist change, even in small ways. Stuart Hill has researched this area for some time and says: "*It is common for proposals for change, which usually imply criticism of current practices, to bring up fear and a diverse range of defensive behaviours. These extend from withdrawal, non-compliance and argument to ridicule, angry confrontation and even violence.*"

There is a certain hierarchy of barriers. I suggest that the primary barriers are psychological. This is to say, that the secondary and tertiary barriers are all more or less influenced by the primary barriers or have their roots in them. However, one has to realize that the division of the barriers is somewhat arbitrary, and there is a strong interdependence between most of them.

Doris Lessing has pondered about all the information, which we could use today to free ourselves from the 'Prisons we Choose to Live Inside', and yet, how little this information is being used. "*In the last fifty or so years, the human race has become aware of a great deal of information about its mechanisms; how it behaves, how it must behave under certain circumstances. If this is to be useful, you must learn to contemplate these rules calmly, dispassionately, disinterestedly, without emotion. It is this information that will set people free from blind loyalties, obedience or slogans, rhetoric, leaders, group emotions.*"

Psychological defenses

Most psychological barriers are based on fear. Fear of the unknown, fear of other people's judgment, fear of not being able to meet expectations etc. Anxiety usually accompanies threatening situations. People feel tense, uneasy, apprehensive, worried, and vulnerable. Since these feelings are unpleasant and uncomfortable, we are often motivated to avoid them. Psychological defense mechanisms are techniques used to avoid, deny, or distort sources of real or perceived threat or anxiety. They are normal and universal features of the human mind that operate consciously, half-consciously and unconsciously to protect the ego from awareness of difficult or painful feelings, facts and ideas. The pain, which comes with the realization that one has contributed to the problems facing agriculture or having done something wrong, immoral or plain stupid usually triggers the defenses. They are also used to maintain an idealized self-image so that we can comfortably live with ourselves.

While psychological defense is normal and positive, it can lead to serious problems, which can raise the barriers to change. Out of the wide variety I like to mention only a few I have experienced myself:

Denial protects us from an unpleasant reality by refusing to perceive it, accept it, or believe it. It is usually closely linked with death, illness, and similar painful and threatening experiences. It is common when the economic survival is at stake. Those of us who have gone through this experience know what I am talking about.

It contrast to conscious and deliberate deception in which we remain aware of the difference between our own truth claims and what one realizes is the actual truth of the matter. In psychodynamic denial we believe our own deceptions and distortions and therefore regards the contrary opinions of others as false and their efforts to convince us otherwise as misguided at best and malevolent at worst.

Rationalization is justifying our own behavior by giving sensible and rational but false reasons for it. It explains to ourselves and to others why we had to act in a certain way, no matter how wrong, stupid or immoral a decision has been.

Repression and suppression prevent painful or dangerous thoughts from entering consciousness and/or keeping consciously unacceptable feelings and thoughts out of our awareness We protect ourselves by repressing thoughts or impulses that are painful or threatening. Feelings of hostility toward a loved one, the names of disliked people, and past failures and embarrassments are common targets of repression.
I like to stress that we all are subjected to these psychological defenses, no matter what our occupation, education or ethnic background. They are universal, which is one of the reasons they present the primary barriers to change.

The threats that trigger these defenses can be real or perceived. They can be threats to or bodies, to our economic well being, to our jobs or social status.

The biggest problem with these reactions is that they can seriously distort the reality and can make it almost impossible to address difficulties. This distortion stands in the way of making adjustments to our live and prevent us from making unavoidable changes. It can lead us deeper into the difficulties, often until it is too late or too costly or impossible for other reasons to make the changes.

What is required in agriculture to make the changes necessary to improve both, the natural environment and the human condition, is nothing less than a paradigm shift.

Although the term paradigm is a buzzword, the concept is not. There are many definitions; for this presentation I like to use the following:

A paradigm is a set of written or unwritten rules, which tells us how to behave in a way that is accepted by the majority. To act against these rules is usually punished by the establishment who benefits from these rules, by social isolation.

In the past fifty years a paradigm has evolved in agriculture that is based on the industrial model. This is to say, it relies almost exclusively on external inputs, large units of production and expensive technologies. This paradigm is supported by the industries, which supply the technologies and materials and control the marketing chain of the production. It is perpetuated through our system of research and education.

Because bureaucracies recruit their personnel from the graduates of this education system, a second level of support for the paradigm has been created. On a third level are the practicing professionals in these systems that have also been trained in the same institutions. Farmers and the general public have been convinced to believe that these are the only possible systems and consequently support them as well. Even though they might realize that it might not work in their favour.

The crisis in agriculture is related to the fact that the existing paradigm cannot solve the new challenges to agriculture in a general sense, or has created problems, which cannot be solved by the very paradigm that created it. Joel Barkers observed, "*…sooner or later, every paradigm begins to develop a very special set of problems that everybody in the field wants to be able to solve and no one has a clue as to how to do it.*"

As paradigms evolve and mature, they either create new problems, which cannot be solved within the parameters of the existing paradigms, or they uncover problems for which the paradigms cannot offer solutions.

Herein lies the dilemma: the crisis in agriculture cannot be resolved by applying more of the solutions to the problems which have created them in the first place.

However, it is rather difficult to change the paradigm. Those who are entrenched in one paradigm can seldom see the solutions offered by another one.

"New paradigms put everyone practicing the old paradigm at great risk. The higher ones position, the greater the risk. The better you are at your paradigm, the more you have invested in it, the more you have to lose by changing the paradigms" says Barker.

Here we have one explanation why those of us who work toward a shift of paradigms have, more often than not, to accept social sanctioning in its many forms. People who have heavily invested in the old paradigm in time, money and prestige do not want to let go.

The distortion of reality as a result of psychological defense mechanisms often prevents them from even seeing the new paradigm and the solutions it offers. The hostile reactions and social pressures resulting from this, prevent even those who see the new paradigm, to speak about it. The barriers to change can be indeed very difficult to overcome. Farmers, consumers, civil servants, academics, researchers – are bonded in collective denial and hostile reaction.

This background is important to know, for it explains why new ideas are often slow in spreading, and that patience is needed in discussions about new solutions to existing problems. It does not need an official inquisition and the threat of burning on the stake for people to be afraid of new ideas.

The breakdown of old paradigms and emergence of new ones is often assisted by social forces. We are a point now that the public begins to demand changes in agriculture, which many farmers have adopted already.

Science

A 1989 study on the barriers to sustainable agriculture in science states: "*Agricultural research has been a very effective tool for increasing both agricultural production and the options for food processing and storage. This increase has been accompanied by major changes in the way our food and agricultural systems are organized. Research on the sustainability of theses systems however, has until recently received little attention or financial support. Surveys of organic farmers have consistently shown that a lack of relevant information and research has been a major obstacle to implementing sustainable farming practices. Paradoxically, much of the research and the research process that has made conventional agriculture so productive has been a barrier to implementing sustainable agriculture.*"

We can be certain that the authors of this study, Rod MacRae, Stuart Hill, John Henning and Guy Mehuys did not receive great praise for this work from the science community. However, their arguments are compelling and are supported by the observations of many other critical scientists.

Reductionism

Reductionism is based on the premise that the sum of all the separate parts is equal to the whole. The scientific strategy is always to attempt explanation in terms of ever more minute entities. It has undoubtedly been the mark of some of science's greatest successes. However, the practice of attempting to understand and simplify areas of knowledge by deliberately excluding more and more relevant data until the eventual explanation, which is arrived at can become so exclusive that it is disconnected from reality.

The scientific approach to breaking things down into constituent parts and dividing knowledge up into compartments has its obvious problems. It destroys the sense of wholeness and complexity, limits interaction of fields of knowledge and ultimately can disconnect people from reality.

Rod MacRae and his team came to this conclusion: *"Holding constant or ignoring all but a few factors under examination means that agricultural research is removed from the reality of ecological systems in which all factors, known and unknown, measurable or not, are constantly interacting. Scientists commonly argue that it is possible to integrate the distinct pieces that result from reductionist science into a whole or system, but with respect to natural systems this has proven largely unsuccessful partly because some of the relationships between the relevant factors are ignored or remain to be discovered. Because of this it is difficult to apply much of the work that has used the reductionist approach to sustainable systems."*

Here we see again the dangerous de-coupling from reality. What is needed is not to abandon the reductionist approach to science but to put something in place that could reduce or even overcome the negative effects of it. Interdisciplinary research and inclusive thinking would go a long way in mitigating some of the unwanted effects of reductionist science.

The opposite of reductionism is holism. Its essence is that changes in one system affect all other systems, no matter how minute those changes might be. The holistic approach to problem solving embraces all influences upon the problem, both internal and external. Rather than dissect the problem into numerous separate and independent functional areas, it recognizes the interdependence of the various systems.

Objectivity

A most serious element in the traditional idea of science is also the view that its findings are 'objective' in the sense of not being influenced 'subjectively', such as by any personal viewpoints, or by social, economic or political influences.

Much of the arguments in trade disputes, issues of human health versus the effects of industrial agriculture or the approval of new technologies, drugs or chemicals claim that they are based on 'the bests science', as if science is always objective and above criticism from below. By throwing science in the debate about the public good, it is imperative that we ask whose science we are talking about.

"Objectivism is the thesis that reality can be known entirely as it is in itself, quite independently of the biases of any observing subject. This has been shown to be untenable as philosophy. Popular though it is, this doctrine has long been rejected by the soundest philosophers and also by scientists in the very forefront of physics since Eddington, yet it is still alas an entrenched dogma held to doggedly in practice by academic tradition, by teachers and also by most scientists the world over" says Robert Priddy, professor emeritus at Oslo University.

Science is indeed still been considered to be objective and neutral. This belief has been shaken in recent years and there is growing evidence that much of scientific research is tainted by the researchers' believes and value systems or worse, by commercial interests and coercion.

Leslie Harris, former president of Memorial University and author of 'The Harris Report on the State of the Northern Cod of the Coast of Newfoundland' said in the CBC 1990 series "Nature of Things: *"I don't think every scientist that I know is deliberately corrupt or deliberately sets out to falsify information or to interpret data wrongly so as to make themselves appear good. But I think it is sort of an exercise in fulfillment that goes on in a subconscious level in which people would like to make their models work. And if they can look at their data in a certain way and to make their model work, that's the way to look at it.*

"The other thing is of course it is not only to make your model work, but it is finding answers that your superior wants to see, and that happens too. And again it is not always a conscious decision, you don't deliberately say I am going out and say you falsify the data to make the minister happy. But you do, nevertheless want to make the minister happy. That is part of your function if you live in a bureaucracy."

Dr. Shiv Chopra , who has been with Health Canada for 30 years, and for 11 years has been a member of the Human Safety Division in the Bureau of Veterinary Drugs testified during the hearings of the Standing Senate Committee on Agriculture and Forestry into the Bovine Growth Hormone evidence: *"The conflict was that our concerns at the BVD, particularly in the human safety division, has been that we have been pressured and coerced to pass drugs of questionable safety, including rBST….. And our ADM has said, 'Well, if it is money and you cannot prove risk, then economics shall prevail and science will take a back seat.' I cannot agree with that kind of attitude that is developing."*

In the same hearings Senator Whelan, former federal Minister of agriculture commented on the objectivity of scientific research: "*….you may noticed my skepticism. Do not forget that I was a minister for 11 years, and research was my favourite topic. I know the things that we did and the things we did not do, and the things we stopped from coming into Canada, et cetera. So I have every reason to be skeptical when we become more dependent all the time on Monsanto and these companies doing the research for us when we know what the other doctor said. They are basically concerned, or not just basically, but they must make money, too. The economics of it are such. So I have strong reservations about less and less public research and big grants by Monsanto to Agriculture Canada for this, and big grants to somebody else from another company for that. I just wonder where our protection is….. I would ask each one of you, has anyone of you been lobbied by Monsanto?"*

Dr. Margaret Haydon, who has been in the Bureau of Veterinary Drugs for the last 15 years before the hearings answered: *"I am not sure 'lobby' is the correct word, but I did attend a meeting back approximately about 1989-90, and Monsanto representatives had met with myself and my supervisor, Dr. Drennan , and my director, Dr. Messier . At that meeting, an offer of one to two million dollars was made by the company. I do* *not know any more about what became of that, but my director indicated after the meeting that he was going to report it to his superiors."*

What these people have been saying can be summed up by a quote from Henry H. Bauer, professor Emeritus of Chemistry & Science Studies, and Dean Emeritus of Arts & Sciences at Virginia Polytechnic Institute & State University: *"This new method of using political clout rather than intellectual merit to make decisions, pork-barreling in other words, is an almost hallowed American tradition but it has only recently been taken up by universities. The American Association of Universities admitted that this pork-barreling is a bad thing, and wished that it wouldn't happen; but it refused to criticize those of its members who were doing it, on the grounds that the need for resources is so great."*

Propaganda

It has become increasingly difficult to distinguish between good factual information and propaganda. Many individuals and organizations to influence and manipulate others have intentionally blurred this line.

Social influence is the science of influence, persuasion, and compliance. It is used to achieve socially desirable outcomes, e.g. reduction of smoking and driving under influence or the use of better diets and more exercise. However, it is most successfully used to achieve the opposite as well, promote smoking, unhealthy diets and wasting money on goods nobody really needs. Or to persuade farmers that, in order to 'feed the world', they have to continue on the unsustainable path of industrial agriculture.

Most people are either unaware of these influences, or when they are, vastly overestimate the amount of freedom they have to make up their own minds. The successful propagandist knows that if he can manage the situation and choose the correct technique, our response to his technique will be as reliable as a spring rain.

Politicians, advertisers, journalists, radio personalities, and others who are interested in influencing human behavior regularly apply its persuasive techniques.

Aldous Huxley wrote about the art of selling: "*Creating and building on hope is one of the aspects of mind-bending, but often this hope is a fraudulent implication of a promise.*

The principles underlying this kind of propaganda are extremely simple. Find some common desire, some wide spread unconscious fear or anxiety; think about some way to relate this wish or fear to the product you have to sell; then build a bridge of verbal or pictoral symbols over which your consumer can pass from fact to compensatory dream, and from the dream to the illusion that your product, when purchased, will make the dream come true".

As simple as the underlying principles are, they are most powerful. In agriculture these techniques have been used successfully to sell everything from snake oil to GMO's. People fall for this especially in times of trouble when they cling to every ray of hope. That makes them susceptible to propaganda; in fact it is often easier to sell the snake oil or silver bullet with the promise of hope than solid, sustainable solutions, which take time to implement.

We witness this again today, in the biotechnology corporation's attempt to convince farmers and the public, that the world needs their products. Because there has not been a need for the development of the transgenic crops that are available today, the bio-tech corporation had to revert to fear and hope based persuasion.

Propagandists love short cuts, particularly those which short-circuit rational thought. They encourage this by agitating emotions, by exploiting insecurities, by capitalizing on the ambiguity of language, and by bending the rules of logic. The history of agriculture shows, they can be quite successful.
It is important to note that even if educators or extension personal do not intend to influence or manipulate perceptions, they do so by virtue of presenting some facts and excluding others. The key question here is, which pieces of 'information' should be chosen to influence farming in a way that it becomes sustainable? Or how much is their knowledge influenced by propaganda or other forms of persuasion?

Second, the framing of messages becomes a crucial issue to consider given the fact that only a limited amount of information is presented to individuals. Those who work towards sustainability in agriculture must, in order to produce intended outcomes, consciously and strategically choose words and messages.

Since the ability to persuade - and to resist persuasion - is directly related to one's success in life, it is amazing that the topic does not receive more attention.

Other barriers

There are many more barriers, they are intertwined and often not visible but powerful nevertheless. It is easy to see how the use or misuse of language can play a role in influencing people. The plague of scientific or technical language to conceal knowledge more than to assist in our understanding is well known and yet there seems to be no inoculation against it.

Propaganda is based on psychology and the use and abuse of symbols and language, the distortion of facts and the exploitation of people's fears, hopes and dreams.

There is an entire set of institutional barriers, as described in 'Institutional Change and Development' in "Getting Down to Earth" by the International Society for Ecological Economics. It classifies environmentally relevant types of institutional failures. It lists three groups: transaction failure, empowerment failure and government failure. They are also intertwined with the barriers already mentioned.

The study and the evaluation of the economics of agriculture are hampered by the unwillingness to deal with the externalities in agriculture. These are the costs and benefits in agriculture, which are rarely ever accounted for.

A recent study in the UK estimates the external cost at £208 per hectare of arable and permanent pasture. These are costs the society has to bear today, and much of it in the future at even accelerated costs.

At the same time, the benefits of ecosystem services are not calculated. How much do we benefit from bio-diversity, from pollinators, from clean air? How much do sustainable farming practices contribute to these services?

Furthermore, who wants to promote something that doesn't make money, like the avoidance of problems and the prevention of environmental disasters or ill health?

The social barriers can be significant. Peer pressure, social sanctioning, and isolation can make the idea of freedom to choose one way or another a mockery.

Organizations are caught in conflicts of policies and goals and funding priorities. They are plagued by ego trips, jealousies and turf wars. Under funding of organizations and exploitation of volunteers who emerge and burn out in cycles have slowed the development of sustainable agriculture everywhere.

At universities, research and other institutions we will find many people supportive of the goals of sustainable agriculture, and yet they do not get involved in any meaningful way, because of time constraints and other pressures.

The demographic reality in agriculture is that the average age of farmers is nearing the common retirement age. Who wants to embark on major changes at that time in life?

"Freedom is generally thought of as the ability to achieve goals and satisfy desires. But what are the sources of these goals and desires? If they arise from ignorance, habitual patterns, and negative emotions - psychologically destructive elements that actually enslave us - is the freedom to pursue them true freedom or just a myth?"

—Chögyam Trungpa ✪

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SPEAKER PROFILE

Hart Haidn received his education in Germany and worked in different agricultural projects in Europe, Africa and Asia before immigrating to Canada in 1978. He operated a seed farm, a seed processing and seed trading business in the Peace River area of British Columbia before moving to Saskatoon in 1997.

Hart is now president of Agricola Consulting Inc., a company specialized in issues relating to sustainable agriculture, community development, and health. He has worked for several farm organizations and as consultant for different private and public organizations.

Hart is the founding chair of the Canadian Centre for Sustainable Agriculture Inc., a non-profit organizations established to promote awareness and education for sustainable agriculture.

His interest is in helping to develop an agri-food system that is sustainable in all stages: economically viable for all participants, ecologically sound, socially just and one, which will provide the same of better opportunities for coming generations. He is convinced that a rapid transition from the destructive forms of industrial agriculture toward sustainable agriculture is not only needed but also possible. The keys to accomplish this will be education, co-operation, the establishment of trust and the formation of broad partnerships with different segments of society.

THE SEARCH FOR SOLUTIONS: THE NEED FOR A PARADIGM SHIFT[*]

— JOHN E. IKERD —

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North American agriculture is in crisis. Until recently, the crisis had been a quiet one. No one wanted to talk about it. Thousands of farm families were being forced off the land, but the agricultural establishment was telling us that their exodus was inevitable – in fact, that it was a sign of progress. Those who failed were simply the victims of their own inefficiency, they said, -- their inability to keep up with changing times, their inability to compete. But, it is not inefficiency or resistance to change that is forcing families to leave their farms – failure is an inherent aspect of our system of farming. Crisis has been a chronic reoccurrence in agriculture. Crisis is an inherent characteristic of the industrial paradigm, model, or way of thinking which dominates North American agriculture.

With farm prices at record low levels for two years running, the agriculture establishment (government, universities, commodity groups, and farm media) has again begun to take notice. The U.S. Congress has passed emergency farm legislation the past two years, universities are beginning to develop farm crisis programs, and the farm crisis stories are showing up in farm magazines and television programs. But even now, the crisis is being blamed on such mundane things as weather, either too good or too bad, problems in Pacific Rim financial markets, too many constraints to free trade, or inadequate government programs. The crisis is a simple matter of supply and demand, they say. The only solutions they propose are to tinker with government policy or, better yet, to simply wait for markets to recover. The only alternatives farmers are being offered are to get big enough to be competitive, get a corporate contract to reduce risks, or get out of farming.

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[*] Presented at Scientific Conference on Organic Agriculture – Building the Bridges, Saskatoon, Saskatchewan, Canada. November 14, 1999.

But, crisis is a chronic symptom of the type of agriculture we have been promoting on this continent for at least the past fifty years -- an industrial agriculture. Reoccurring financial crises are the consequence of farmers being encouraged to industrialize – to become more specialized, standardized, and larger in size so they can reduce their costs and in turn to lower costs of food to consumers. The displacement of family farmers in the process is rationalized as "freeing people from the drudgery of farming" so they can find better jobs in the cities.

The promise of profits keeps farmers on a *technology treadmill* resulting in ever larger and ever fewer farms. Farmers adopt new production enhancing technologies to cut costs and increase profits. But, as more farmers adopt these technologies, resulting increases in production cause prices to fall, eliminating profits for the early adopters and driving those who fail to adopt or adapt soon enough out of business. This technology treadmill has been driving farmers off the land for decades. And as farmers become fewer, farms become larger. Those farmers remaining in business after each crisis must continue to get bigger ever faster just to survive.

However, the farm crisis of the 1990s has an added dimension. The current crisis reflects an attempt by giant agribusiness corporations to seize control of American agriculture, to move beyond specialization and standardization, to centralize command and control – to complete the industrialization of agriculture. This final stage of industrialization could well spell the end of farming – at least the end of farming as we have known it. The food and fiber industry most certainly has a future -- people will always need food, clothing, and shelter, and someone will provide them. But there may be no future in real farming anywhere unless we challenge the conventional industrial model of agriculture. If there is to be a future in farming, at least in farming as we know it, we must adopt a new and fundamentally different paradigm or philosophy of farming.

The Business of Paradigms

Joel Barker, in his book, The Business of Paradigms, defines a paradigm as mental models or mindsets that defined how we see and deal with particular situations in life. Our paradigms determine how we interpret the world around us, and thus, how we go about seeking solutions to our problems and pursuing our opportunities. According to Barker, all paradigms do three basic things – paradigms establish boundaries, set standards for behavior, and define success – implicitly or explicitly. He uses the game of tennis as an analogy to illustrate the concept of paradigms. Tennis courts are standard in size and out-of-bounds are clearly marked. The ball must be hit within these bounds to *stay in play*. The ball must be struck with a tennis racket, not with the hand or any other object, and the ball is allowed to bounce only once before it is returned over the net. The player who is able to keep the ball in play most successfully through a given number of serves and volleys first wins sets, and by winning sets, wins the tennis match.

Paradigms may be simple, as in the case of games, or extremely complex, as in the case of organizational models. In general, industrialization is an organizational paradigm characterized by specialization, standardization, and centralization of decision-making or control. First, the industrial paradigm has clearly defined boundaries established by society and the natural environment. The natural environment and natural resources are considered *external*, or out of bounds, by industrial decision-makers. An industry may have impacts on the environment and the industry may take resources from nature, but nature is *outside* of the business. Industrial firms likewise considered society to be an *external* factor that constrains or sets bounds on the actions of industrial firms. Thus, the *game* of industrialization must be played within limits or boundaries set by nature and society.

Second, within the limits allowed by nature and society, industrial firms have a wide range of permissible choices and actions. In fact, almost anything that is physically possible and deemed legal by society is permissible. Finally, the goal of industrialization is to maximize profits and growth of the business organization. The basic strategies of industrialization are specialization, standardization, and centralization of command and control in order to achieve economies of scale. But in fact, almost anything possible and legal that increases profits and growth is encouraged. The business that makes the most profit and accumulates the most wealth wins. Such is the nature of the industrial paradigm that has come to dominate American agriculture.

The Industrialization of U.S. Agriculture

Paradigms, such as industrialization, become dominant because they are found to be capable of exploiting new opportunities or solving problems that previous paradigms could not solve. The industrial era, in general, was fostered by a host of interrelated and complex developments, but among the most important was the discovery of large supplies of easily accessible fossil fuels. The industrialization of the U.S. and other "developed" economies was made possible, in large part, by the various means of exploiting vast supplies of fossil energy.

In the U.S., agriculture was industrialized in order to support the industrialization of the U.S. economy as a whole. At the turn of the century, America was an agrarian society. Most of our total resources were spent on the necessary tasks of feeding and clothing ourselves. People had to be freed from producing food and fiber to provide workers for the factories and offices of a growing industrial society. The real costs of food and fiber had to decline if consumers were to have discretionary income to buy the things that the factories and offices would produce.

Agriculture first became specialized as diversified crop and livestock farms were replaced by specialized crop and livestock operations. Next agriculture was standardized through elaborate sets of grades and standards which defined the physical characteristics of agricultural products and through the development of "best management practices" to guide production. Control of agriculture is now becoming centralized, as large agribusiness corporations take over control of all stages of production and marketing decisions from genetics to retailing, either through ownership or contractual arrangements.

Each step in the industrialization process has made it possible for fewer people to provide more people with more food for less money. Industrialization of agriculture began in earnest when commercial fertilizers and pesticides replaced diversification and crop rotations in maintaining fertility and controlling pests. This allowed farmers to specialize in particular commodities and to standardize production practices by gaining greater control over production processes. The agricultural sector has been among the last to become centralized, and thus fully industrialized, but the driving force of change has long been to make farms perform as factories without roofs with fields and feed lots operating as much as possible like factory assembly lines.

Industrial strategies of the past century were highly successful in reducing the claim of food and fiber production on the nation's human resources. For example, the 1895 U.S. Yearbook of Agriculture indicated that 42 percent of people in the U.S. were employed on farms in 1890 (USDA, 1895). This compares with less than 2 percent of the total U.S. population living on farms a century later. In addition, those living on farms today earn well over half of their total household income from non-farm sources (USDA 1995). U.S. consumers now spend just under 11 percent of their income on food, and farmers get only about 21 cents out of each dollar spent for food (Elitzak, 1999). Over half of the farmer's share goes to pay for purchased inputs, leaving the farmer less than a dime out of each dollar spent for food to cover costs of value added on farms.

The industrial paradigm succeeded in exploiting the opportunities of cheap fossil energy and a multitude of related industrial technologies. Food systems in the industrialized nations are now the envy of the rest of the world – at least in terms of their productivity. Farmers and others have been freed from the subsistence living that characterized earlier times.

However, known stocks of fossil energy are being rapidly depleted as potential societal gains from still further increases in agricultural efficiency are dwindling. In addition, the industrialization of agriculture has generated a whole new set of growing economic, environmental, and social concerns that may soon, if not already, outweigh its declining benefits.

The Hidden Costs of Industrialization

The industrialization of agriculture has raised a litany of rural environmental and social concerns as agriculture has strained against its social and environmental boundaries continually to increase profits and growth. The agricultural establishment tends to shrug off the concerns of rural advocates as being uninformed, or at least out of touch with the reality of modern day farming. However, many farmers, openly or secretly, share concerns about the impacts on current farming practices on the land

and rural communities. Many of the concerns relate directly to concepts of stewardship and community -- values deeply held by farmers of all times past.

It is not necessary to belabor the negative environmental and social impacts of industrialization. However, it is necessary that farmer and society assess, in some way, the hidden costs of our industrialized system of food and fiber production. The environmental and social consequences of industrialization are not illusions of someone's imagination. They are real. Whether or not one chooses to consider them is not a matter of fact, it is a matter of belief concerning their importance. It's a matter of alternative paradigms, not of reality versus fiction.

John Ikerd
(photo by Darryl Amey)

First, concerns are growing regarding the continuing effectiveness of commercial inputs and other technologies necessary to support large-scale, specialized cropping systems. Increased concentration of single crops within geographic regions increases pest pressures. In addition, insects and weeds are becoming resistant to pesticides and require higher rates of application or new, more costly pesticides for control. Previously fertile soils in some areas have lost organic matter and natural fertility through mono-cropping, conventional tillage, and removal of crop aftermath year after year. Less organic matter left in the soil means less microbial activity, less ability to hold water, and less availability of nutrients in root zones. Less active organic matter in the soil means lower yields from a given level of water and fertilization or higher fertilizer and irrigation costs to maintain yields.

Water tables in some of the major irrigated food producing areas are declining as rates of irrigation surpass rates of natural regeneration of aquifers. Residues of salt and other minerals on irrigated land present an added concern. Soil erosion also remains a significant problem in modern agriculture. Following the "dust bowl" day of the 1930s, farmers had made significant advances in soil conservation, at least until U.S. farmers intensified row crop production for growing export markets during the 1970s. Soil erosion again became a major public issue in the U.S., addressed in conservation provisions of the1985 farm bill. Farmers have made significant progress since then in conserving soil through conservation tillage and other measures. However, soil erosion remains a major public issue.

Other costs of industrialized crop production are beginning to show up in the environment of farm families, farm workers, and rural residents. Health risks in handling pesticides, for example, have become a major farm-safety concern. Risks of chemical contamination of drinking water and risks of pesticide residues in food are important public perceptions, regardless of the facts concerning actual risk levels. The opening of global food markets seems to have heightened public concern for food safety. Furthermore, the emergence of genetically modified organisms (GMO's) has added intensity of food safety debates in the global arena.

Industrial livestock production raises a whole different set of concerns. Water pollution associated with livestock feedlot wastes may prove more challenging than controlling nutrient leaching and runoff from commercial fertilizers used on crops. The energy required to produce meats, compared with direct human consumption of grain, is an oft stated resource concern. Routine use of antibiotics and residues of drugs and hormones in meats may be at least as controversial as pesticide residues in fruits and vegetables. The European ban on the animal growth hormone, DES, has fueled a major world trade dispute. Animal welfare is a public issue of increasing social concern that could have major impacts on livestock production in the future. Large-scale, commercial cattle feeding, poultry, and dairy operations have been the primary focus of past concerns. However, the rapid growth in large-scale hog operations has shifted the public spot light to pork production.

The industrialization of agriculture also has had obvious negative impacts on economic and social quality of life in rural communities. Larger, more specialized farming operations have meant fewer farming families, as fewer people are needed to produce food and fiber using industrial farming technologies. Not only have purchased inputs been substituted for land, but machines have been substituted for labor, and technology has been substituted for management. The unneeded farm families have been squeezed out of agriculture as a natural economic consequence of the substitution of capital and technology-based inputs for human resources. Industrial technologies reduced costs of production and seemingly promised increased profits and higher farm incomes. But, the consequent increases in production, reduced market prices and ultimately reduced farm incomes instead. Attempts to mitigate the effects of surplus production through export expansion have instead created a system where farmers are even more dependent on cost reducing technologies to remain competitive in global markets. This continual industrialization process has ensured that economic returns to those remaining in the shrinking agricultural sector were kept well below those in growing sectors of the economy.

The persistent gap between farm and non-farm income was an economic necessity for moving unwilling people and resources out of agriculture and into other occupations and uses. But there were costs associated with this migration out of agriculture. These costs have included "social disorganization, shrinking rural economic bases, declining rural communities and institutions, and the specter of a permanent underclass in the cities" (Glover, 1988). Crisis is a chronic symptom of the industrialization of agriculture.

Today's farmers can choose to minimize the importance of the costs of industrialization, simply chalk them up to the inevitable consequences of "progress," or they can accept them as signals that there is something fundamentally wrong with today's agriculture. During this final stage of industrialization, the centralization of corporate controls over production, more and more farmers seem to be willing to reconsider the prevailing industrial paradigm for farming. They know down deep that an agriculture that continually degrades its natural resource base and degrades the quality of life in rural communities is not sustainable. They still value stewardship and community as deeply held principles by which they would like to be able to live their lives. Slowly, they are coming to realize that there is no future for the independent farmer in an industrialized agriculture. Some are at least willing to consider a new paradigm for farming.

Sustainable Agriculture: A New Paradigm for Farming

No one can possibly know the future with certainty. Conceivable, the industrial model might be fine-tuned, refined, or redesigned, resulting in a new model capable of meeting the ecological and social requirements for long run sustainability. On the other hand, a new paradigm or philosophy of farming, fundamentally different from the industrial model, may be required. Albert Einstein claimed that a problem had to be solved at a higher level of thinking than the thinking that led to its creation. Problems related to industrialization may have to be solved using a fundamentally different paradigm that reflects a higher level of thinking.

Such a new paradigm for farming is emerging under the conceptual umbrella of sustainable agriculture. The sustainable agriculture paradigm may not be fully understood for some time to come. However, this post-industrial approach to farming is fundamentally different from industrialization. The new sustainability paradigm clearly considers ecological and social impacts to be "within" rather than "outside" of the boundaries of decision making. Ecological soundness and social responsibility are seen as positive goals for sustainability rather than negative constraints to economic growth. The constraints or boundaries of the sustainability paradigm are the laws of nature, including human nature. All else, including farming, is subject to the inviolate laws of nature.

The new paradigm considers the economic, ecological, and social dimensions of sustainability to be inseparable. Fields, farms, and communities are considered to be wholes that are made up of smaller wholes and make up still larger wholes. Thus, the approach to farm decision-making and management must be "holistic." The challenge is to comprehend the complexities of wholes rather than attempt to reduce wholes to simpler and easier understood elements or components. Success in the new paradigm is measured against the goal of sustainable economic, ecological, social progress, rather than short run profits and growth. A sustainable agriculture must be capable of maintaining its productivity and value to human society indefinitely. Any sustainable system must meet the needs of those of the present while leaving equal or better opportunities for those of the future.

The new sustainable model implies greater reliance on human resources, in terms of the quality and quantity of labor and management, and relatively less reliance on land and capital. Each complex whole is unique and requires a unique management strategy. In fact, the human mind may be the only mechanism capable of coping with the multitude of complexities implied by this new paradigm for farming. Success of the new paradigm for farm decision making may well depend on success in empowering more people with information and knowledge needed to manage holistically.

Farming with the new sustainable paradigm would require more farm operators, more farm laborers, and more farm families than would an industrial system of farming. In addition, operators of these new paradigm farms would be motivated by a new mix of objectives. Social considerations are balanced with environmental and economic goals. Social goals may cause such farmers to show a preference for local markets and local input-supply sources, so long as this preference does not threaten their economic survival. Resource stewardship is balanced with social and economic goals, enhancing the productivity of the local natural resource base over time rather than depleting it. Economic progress is sustained by social and ecological progress.

A fundamental shift in the balance of returns to people versus land and capital must be brought about, by one means or another, if the new paradigm is to be successful and more families are to be able to farm successfully. Smaller, diversified farms will remain commercially competitive with larger specialized farms only if human resources can be substituted economically for other resources and commercial inputs. By implication, farmers who succeed with the new paradigm must be more productive as "people." They cannot expect to earn a larger return for their management and labor, thereby reducing their reliance on land and capital, unless they possess unique management skills and working abilities. Therefore, success of the new sustainable paradigm for farming depends on changing the focus of public and private development strategies from enhancing the productivity of capital to enhancing the capabilities of people.

Economics: The Eroding Foundation for the Industrial Paradigm

The most fundamental of all *beliefs* supporting the industrial paradigm, is the *belief* in the economics of self-interests. In fact, contemporary economic theory provides the conceptual foundation for the industrial paradigm – economics sets the boundaries, determines the rules of conduct, and defines success. Free market economics and the industrial era share the same general time of beginning – more than 200 years ago. However, contemporary economic theory, like industrialization, is based on a set of *beliefs* that is increasingly subject to logical challenge in the world of today.

The conventional wisdom seems to be that only *the market* is capable of ensuring that things are done right. Anything that interferes with *the market*; the government, public attitudes, or cultural values, for example; by definition creates economic inefficiency and is bad for society. Few people are aware of the origin of this *belief*, and even fewer seem willing to challenge it. In fact, the few who dare to question *the market's* sanctity are quickly attacked by people in powerful places with obvious self-interest in perpetuating *the belief* -- including an army of economists.

Current belief in the sanctity of *the market* can be traced back to statements by Adam Smith, the father of contemporary economic theory, in his book, The Wealth of Nations. *"It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self love, and never talk to them of our necessities but of their advantages"* (p. 7). Later, in reference to trade, Smith states, *"he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention"* (p. 199). These statements provided the foundation of the contemporary economic wisdom -- that pursuit of short run self-interests is transformed into achievement of the public good, as if by an *invisible hand*.

However, Adam Smith didn't say that pursuit of maximum profits and growth by large, corporate organizations would result in the greatest benefit to society. Smith was simply making observations of the world economy of the time. The economy of Smith's day was quite different from today. In the late 1700s, most economic enterprises were small, family operations. Few enterprises were large enough to have any impact on the marketplace as a whole. Most market transactions were direct between buyer and seller -- there were few opportunities for deceptive sales practices. Trade was mostly in basic commodities – every seller's wheat, bread, or shoes were pretty much the same as those offered for sale by other sellers. Under these conditions, profits were quickly competed away in highly competitive local markets.

Human populations back then were small enough and technologies were sufficiently benign that people could have little permanent impact on their natural environment – at least not on a global scale. Strong cultural, moral, and social values dictated the norms and standards of "acceptable" individual behavior. There were many things that people just would not do – regardless of the potential profits.

In the environment within which conventional economics was born, in Smith's time, pursuit of self-interest might well have served the interests of society reasonably well. But, the world has changed over the past 200 years. In fact, none of the important assumptions of truly competitive markets -- the prerequisite for efficient resource allocation by free markets – are valid in the economy of today.

Today, giant corporations dominate almost every sector of local and global economies. Through mergers, joint ventures, and strategic alliances, corporations have formed "virtual" monopolies. Producers and consumers have become disconnected, geographically and conceptually, as a consequence of industrialization. Consumers no longer have any personal knowledge of where their products come from or of who is involved in their production. They must rely on a complex set of standards, rules, and regulations for product information, and today's advertising consists of "dis-information" by design. Superficial product differentiation abounds -- through processing, packaging, advertising, and marketing gimmicks -- making price competition impotent if not impossible.

In the world of today, there is no logical reason to believe that some *invisible hand* will transform pursuit of greed into societal good. Yet the belief persists – at best out of habit or resistance to change, but more likely as a justification of the continuing greed of the economically powerful.

In addition, human activities are no longer ecologically benign -- if they ever really were. The pressures of growing populations and rising per capita consumption are now depleting resources of the land far faster than they can be regenerated by nature. Wastes and contaminants from human activities are being generated at rates far in excess of the capacity of the natural environment to absorb and detoxify them. The human species is now capable of destroying almost everything that makes up the biosphere we call Earth, including humanity itself.

The society of Smith's day was weak on economics – hunger, disease and early death were common -- but it had a strong cultural and ethical foundation. However, that social and ethical foundation has been seriously eroded over the past two centuries -- as glorification of greed has replaced true self-interest. Civil litigation and criminal prosecution seem to be the only constraints to the unethical and immoral pursuit of profit and growth.

In addition, contemporary economics has always been fundamentally incapable of dealing with *relationships* among people. This fact is freely admitted even in basic economics text books. In economics, a market is nothing more than a collection of independent individual consumers. Human institutions such as families, communities, nations and cultures have no economic relevance – other than as collections of individuals. Thus, one gains no economic well being from relationships -- from identifying with or being a part of any particular family, community, nation or culture. Believing, trusting, sharing, caring, and serving are but empty words to the economist. Concepts such as faith, hope, and love are ignored in economics -- they are just illusions of the human imagination.

In economics theory, the environment is a passive entity, and thus, has no specific active relationship to people. The environment is always external, or outside, the economic system. The environment may be ignored, treated as an external constraint, or as something that is impacted by economic activity within. But, the environment is always treated as something separate and apart from people and the economy. In economics, the sense of *rightness* that comes from our attempts to be good stewards of the earth's resources contributes nothing to our quality of life. It's economically irrational to want to leave as much and as good as we have today for the benefit of future generations.

Clearly, contemporary economics is the foundation for the industrial paradigm. But, does contemporary economics really make sense as a guiding philosophy for humanity? Do we actually believe that the greatest greed results in the greatest good? Or are we a society that is being shamed into doing things that don't make sense because we don't want to be publicly degraded and labeled naïve and unrealistic, as being economically illiterate and irrational?

Changing Paradigms; May Be Easier Than We Think

The principles of community and stewardship are deeply rooted in the culture of rural people. It seems likely that most farmers of today, if not all, still value stewardship and community as important principles of their lives. Some will argue that farmers of today are businesspeople, first and foremost, and that farming today is a business, not a way of life. However, it seems far more likely that farmers of today are being forced, or at least coerced, to act differently than they believe. They have been led to believe that economics must be given priority over stewardship and community, and that ethical and social constraints must be expanded or removed to allow for more profit and growth. Today's farmers may well be reluctant to champion their own deeply held beliefs for fear they will be labeled as old fashioned, emotional, or lacking in business savvy. They see themselves as trapped in a paradigm that conflicts with their fundamental beliefs.

However, the belief that farming must be a business, first and foremost, is a belief, not a fact. The supremacy of profit and growth over all else is nothing more than an element of the industrial paradigm derived from outdated economic theory – it is a belief not reality. All paradigms are based on beliefs that arise from specific worldviews. One cannot prove or disprove worldviews. Any science that might be used to prove or disprove them, in fact, depends on a specific world view, which in turn is based on beliefs. Economics has its foundation in Adam Smith's view of the world as it was more than 200 years ago. It is highly questionable whether that worldview has any real relevance to the world of today. The industrial paradigm arose to solve the problems and exploit the opportunities of 200 years ago. The problems and opportunities of today have little relevance to those of 200 years ago.

It's true, people will pursue their self-interest – it is an inherent aspect of being human. But, people, by nature, do not pursue only their narrow, individual self-interest. It is within the fundamental nature of people also to care about other people and to accept the responsibilities of humanity to take care of the earth. People are perfectly capable of rising above the *economics of greed* to an *economics of enlightenment*. An *invisible hand* can still translate the pursuit of self-interests into the greatest good for society, but only if each person pursues a *higher* self-interest – a self-interest that values relationships and stewardship as important dimensions of our individual well being.

Our higher self-interests includes narrow self-interest (which focuses on individual possessions), but it also includes interests that are shared (which focuses on relationships, community, and social values) and interests that are purely altruistic (which focuses on interests one pursues only out of a sense of stewardship, ethics, or morality). All three – individuality, relationships, and stewardship -- contribute to one's well being or quality of life, but not in the same sense that greed might enhance one's material success. Each contributes to a higher sense of quality of life which explicitly recognizes that each individual is but a part of the whole of society, which in turn must conform to some higher order or code of natural laws.

The Dalai Lama of Tibet puts it in slightly different terms, "*If you think in a deeper way that you are going to be selfish, then be wisely selfish, not narrow-mindedly selfish. From that viewpoint, the key thing is the sense of universal responsibility, that is, the real source of strength, the real source of happiness. From that perspective, if in our generation we exploit every available thing, trees, water, mineral resources, or anything, without bothering about the next generation, about the future, that's our guilt, isn't it? So if we have a genuine sense of universal responsibility as the central motivation and principle, then from that direction our relations with the environment will be well balanced. Similarly with every aspect of relationships: our relations with our neighbors, our family neighbors and country neighbors, will be balanced from that direction*" (p. 179).

Sustainable agriculture provides a possible new paradigm by which farmers can pursue their higher self-interest. They can get off the industrial technology treadmill that forces them to exploit the natural environment and their neighbors in the endless pursuit of ever-illusive profits. They can use the imagination and creativity of their uniquely human mind to break free of the inevitable corporate dominance of an industrial agricultural. They can learn to manage holistically – balancing the economic, social, and spiritual aspects of their lives. They can pursue a life of quality, rather than a life of endless struggle to accumulate land and capital.

There are no blue prints for the paradigm for sustainable farming. But a few fundamental principles are beginning to emerge. In general, the opportunities arise directly from exploiting the weaknesses of industrialization – of specialization, standardization, and centralized decision making. The new American farm tends to rely instead on the advantages of diversity, individuality, and decentralized networks of interdependent decision-makers.

Farming sustainably is no simple task. But, thousands of farmers are already finding ways. They are finding ways to sustain a desirable quality of life for themselves and to support their local communities while being good stewards of the land and of the natural environment in general. They may carry the label of organic, low-input, alternative, biodynamic, holistic, permaculture, or no label at all, but they are all pursuing common economic, ecological and social goals. They do not manage to achieve separate environmental, social, or economic objectives, but consider the economic, ecological, and social to be but different dimensions of the same whole. They do not choose among trade-offs, but instead search for harmony.

These farmers try to farm in harmony with the natural environment – to complement nature rather than control it. They use practices such as management intensive grazing, integrated crop and livestock farming, diverse crop rotations, cover crops, and inter-cropping. They manage their land and labor resources to harvest solar energy, to use the productivity of nature, and thus, are able to reduce their reliance on externally purchased inputs. They fit what they do with their unique resource in order to reduce costs and increase profits while protecting the natural environment.

Organic farming is but one approach to farming sustainably, however, it may be used to illustrate the sustainable agriculture paradigm. True organic farming is as much a philosophy of life as a method of production. Organic farming is based on nature's principles of production – on farming in harmony with nature rather than trying to conquer nature. Organic farming systems integrate crops and livestock enterprises or use complex crop rotations to capture solar energy, recycle waste, and regenerate the soil. Organic farmers also believe in living in harmony with other people – in cooperating rather than competing. Healthy food, a healthy environment, caring communities, and a strong society are seen as the natural products of pursuing an organic philosophy.

The new sustainable paradigm farmers market in the niches. They market direct to customers through farmers markets, roadside stands, community-shared agricultures (CSAs), home delivery, or by customer pick-up at the farm. They use everything from the Internet to word of mouth to advertise their services. They market to people who care where their food comes from and how it is produced – locally grown, organic, humanely raised, hormone and antibiotic free, etc. They are able to reduce costs and increase profits while protecting the natural environment and supporting their local communities.

By their actions, these farmers are defining a new paradigm for farming. It takes time for any new paradigm to prove its worth – to prove that it can solve the pressing problems of the day and open new opportunities. But this new paradigm of sustainable agriculture, an agriculture that allows farmers to pursue their higher self interest – their personal, inter-personal, and spiritual quality of life – is a paradigm that makes common sense to farmers. ○

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SPEAKER PROFILE

John Ikerd was raised on a small dairy farm in southwest Missouri and educated at the University of Missouri with BS, MS, and PhD degrees in Agricultural Economics. He was employed for three years with Wilson Foods in Kansas City, MO, Atlanta, GA, and Detroit, MI between BS and MS degree work. Dr. Ikerd worked in Extension Agricultural Economics positions at North Carolina State University (1970-76) and Oklahoma State University (1976-84) and was Head of Extension Agricultural Economics, University of Georgia (1984-89). In 1989 he returned to the University of Missouri under a cooperative agreement with the USDA, to provide state and national leadership for research and education programs related to sustainable agriculture. He retired and received appointment as Professor Emeritus of Agricultural Economics on February 1, 2000.

His work included National Sustainable Agriculture Projects with the USDA SARE Program, the development of Farm Decision Supports Systems for Sustainable Agriculture (PLANETOR), Sustainable Agriculture Education Council (SA Professional Development Program), Addressing the Quality of Life Dimension of Sustainable Agriculture, Regional Liaison-South and Northeast- SA Professional Development Program, and State Co-coordinator of SA Professional Development Program for Missouri.

Since retiring from the University in early 2000, Ikerd spends most of his time writing and speaking out on issues related to sustainable agriculture with an emphasis on the economics of sustainabilty. In addition, he continues as the project leader for a three-state, five-year program, with funds from the W.K. Kellogg Foundation, which links sustainable agriculture and sustainable rural community development. Dr. Ikerd plans to continue writing and speaking out on economic and sustainability issues into the foreseeable future.

SYSTEMS FOR SUSTAINABLE AGRICULTURE: APPROACHES, TRADEOFFS AND NEEDS

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All systems of agriculture practiced today can be seen as having a potential for improvement and contributing toward a more sustainable agriculture. The major differences in approach and in the types of services needed to serve the development of Sustainable Agriculture are between Industrial and Ecological systems rather than between organic and conventional systems (defined by inputs). Support services offered by private and public institutions are adequate for Industrial systems, but not for Ecological systems.

Sustainable agriculture has been described as a systems approach to farm planning and decision-making.[1] I offer a perspective on the decision-making framework and the tradeoffs involved in managing biological processes on the farm under different approaches to Sustainable Agriculture. By decision-making framework, I refer to the knowledge base and support services and technologies that are drawn upon in making those decisions. Tradeoffs I will consider are those between the goals of Sustainable Agriculture pertaining to the biological functioning of the farm. I will consider those to be high yields, low need for and high efficiency in use of material inputs, minimal adverse effects on human and ecosystem health, and provision of ecosystem services.

The 3 R's

Stuart Hill and Rod MacRae and others [2,3] thought a lot of this out in the 1980s and their concepts are still very relevant. At the turn of the century, we are still talking about what's involved at a very fundamental level in the conversion to Sustainable Agriculture, and about the type of support services required. MacRae et al.[3] described the conversion from conventional to sustainable farming as involving three overlapping strategies or stages: Efficiency, Substitution and Redesign (Box1) or the 3 R's: Reduce, Replace and Redesign. They viewed conversion as an evolutionary, more or less unidirectional change, from non-sustainable to sustainable practices and systems.

Box 1:

Efficiency, Substitution and Redesign (Reduce, Replace and Redesign)

Transition to sustainable practices involves three overlapping stages: efficiency, substitution and redesign. Of the three, redesign is the most important but has received the least attention. In the efficiency stage, conventional systems are altered to reduce both consumption of resources and environmental impact, for example by banding fertilizers, monitoring pests, optimal siting of crops and fields, and optimal timing operations. In the substitution phase, finite resources and environmentally disruptive products are replaced by those that are more environmentally benign, for example, replacement of non-specific pesticides by biological control. The redesign stage avoids problems by site and time-specific design and management approaches. The farm is made more ecologically and economically diverse, self reliant in resources and self-regulating.

(Adapted from MacRae et al.[3]).

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In the short interval since these concepts were elaborated, there have been far-reaching changes in farming systems, and in the technologies and concepts related to farming.

- It is now generally accepted that "conventional" farming, as we have known it, especially the more industrial forms is highly environmentally degrading.[4]

- The concept of "ecosystems services" has become popularized and quantified monetarily. It is the idea that ecological systems provide essential services such as water purification and a supply of pollinators free of charge and that if we lose those systems we will have to pay to replace them with constructed systems. Globally, the value of ecosystem services provided free of charge is estimated as at least two times the world's GNP.[5]

- There is a high level of awareness about food quality, and a high demand for nutritious, safe food. One result has been the introduction and wide adoption of organic certification codes that make certain guarantees about the types of inputs used to produce food, and that encourage environmentally sound practices.

- There has been considerable response to environment and food issues within the context of "conventional" agriculture both conceptually and in practice. Some of that response has involved adoption of practices that have been maintained or developed by organic agriculturalists in the interim such as the use of cover crops and compost. Some of the response involves divergence in approaches, most notably the introduction of transgenic organisms (GMO's), and some of it involves new kinds of tools that have considerable value for both types of systems, such as computer modeling, and arguably,[6] Precision Agriculture.

- There is far more acceptance of organic approaches within the institutional context, and even more so within business. We are seeing rapid growth of small-scale organic enterprises and at the same time an aggressive pursuit of what could be called Industrial Organics. Like other forms of the new wave of industrial expansion, Industrial Organics are fueled in large part by modern information and control technologies and global trade.

A matrix of farm types

Thus today, I suggest that it is appropriate to superimpose the 3R's on a matrix of farm system types (Table 1, Figure 1). Each type has some inherent limitations in relation to the goals of Sustainable Agriculture. Other limitations are ones that could potentially be resolved through application of Reduce and Replace strategies. Moving from one system to another involves Redesign.

The matrix distinguishes on the one hand, types of material inputs (Conventional/Organic) and on the other, a management gradient going from Intensive/Industrial to Extensive/Ecological modes. The boundary between Conventional and Organic amendments is sharply defined to correspond to the preciseness of prohibitions for certified organic production and for which all amendments must meet certification standards; on the conventional side, amendments could range from 0-99% organic but would not be 100% organic. Associated with the Industrial/Ecological axis are gradients in the degree to which farms are integrated into and dependent on the landscape, the quantity of inputs, the degree to which cultivars and breeds are locally adapted, and in the reliance on external control agents. The Intermediate category corresponds to farms that include components of both Ecological and Industrial systems. For example, the barn in a dairy farm could operate in Industrial mode, and fields in Ecological mode. Most family farms would probably fall in the Intermediate category.

Table 1:

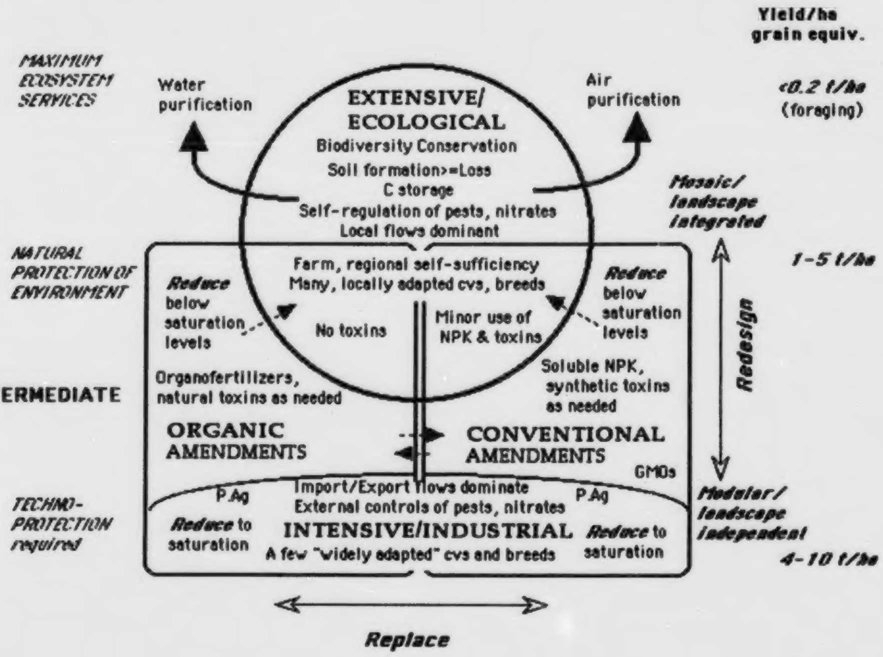
Characterization of farm systems and the degree to which they achieve 8 goals* of Sustainable Agriculture

Goal achievement is rated as routine ♦, possible (♦),or inherently not achievable X. EP: Environmental Protection ES: Environmental Services.

Amendments: **Management**	**Conventional Amendments (+/-organic amendments)**	**Certifiable Organic Amendments (only)**
Intensive/ Industrial --> Highly specialized --> Large input/output flows of nutrients --> Widely adapted cvs and breeds (dependent on high inputs) -> External control agents	*Goal achievement* Production.....♦ Inputs............X Food Purity...(♦) EP Excess.....(♦) EP Toxins.....(♦) EP Genetics....X ES Diversity...X ES Frag'n......X	*Goal achievement* Production....(♦) Inputs............X Food Purity....♦ EP Excess.....(♦) EP Toxins......♦ EP Genetics....♦ ES Diversity...X ES Frag'n......X
INTERMEDIATE	*Goal achievement a combination of those above and those below*	*Goal achievement a combination of those above and those below*
Extensive/Ecological --> Diversity of crops, livestock and wildlife --> Local and internal flows of nutrients dominant --> Locally adapted strains --> Internal control of pests	*Goal achievement* Production...(♦) Inputs..........(♦) Food Purity..(♦) EP Excess.....♦ EP Toxins....(♦) EP Genetics...X ES Diversity..♦ ES Frag'n.....X	*Goal achievement* Production...(♦) Inputs........... ♦ Food Purity...♦ EP Excess.....♦ EP Toxins.....♦ EP Genetics...♦ ES Diversity..♦ ES Frag'n....X

*Goals:
Production: High level of production of exportable product per unit area of farm
Inputs: Low levels of inputs/purchased services
Food Purity: Lowest possible levels of agrotoxins and no transgenic components in food
EP Excess: Environmental Protection-Lowest possible levels of nutrients and BOD in effluents
EP Toxins: Environmental Protection-Lowest possible levels of agrotoxins in effluents
EP Genetics: No possibility of transgenic escapes
ES Diversity: Environmental Services-high level of on-farm biodiversity
ES Frag'n: Environmental Services- fragmentation of natural habitat below critical levels for wild species.

Label Figure 1:
Schematic representation of farm system types, their benefits, requirements and application of the 3R strategies (Reduce, Replace and Redesign).


Yield/ha grain equiv.
MAXIMUM ECOSYSTEM SERVICES
Water purification
EXTENSIVE/ ECOLOGICAL
Biodiversity Conservation
Soil formation>=Loss
C storage
Self-regulation of pests, nitrates
Local flows dominant
Air purification
<0.2 t/ha (foraging)
Mosaic/ landscape integrated
NATURAL PROTECTION OF ENVIRONMENT
Farm, regional self-sufficiency
Many, locally adapted cvs, breeds
Reduce below saturation levels
No toxins
Minor use of NPK & toxins
Reduce below saturation levels
1-5 t/ha
Redesign
INTERMEDIATE
Organofertilizers, natural toxins as needed
Soluble NPK, synthetic toxins as needed
ORGANIC AMENDMENTS
CONVENTIONAL AMENDMENTS
GMOs
TECHNO-PROTECTION required
P.Ag
Import/Export flows dominate
External controls of pests, nitrates
P.Ag
Reduce to saturation
INTENSIVE/INDUSTRIAL
A few "widely adapted" cvs and breeds
Reduce to saturation
Modular/ landscape independent
4-10 t/ha
Replace

Ecosystem services

An Industrial Organic farm in this scheme might be one that makes use of MSW (Municipal Solid Waste compost to support a large export flow, uses intensive monitoring and biological control to control pests and uses a constructed wetland to ensure that excess nutrients and BOD (Biological Oxygen Demand) do not reach waterways. Such farms - although not dependent on ecological processes at the landscape level to the extent that Ecological Organic farms are, make use of ecological processes internally. They also contribute ecosystem services by processing urban and other bulk organic wastes and through sparing effects. Thus they play a vital role in the global ecosystem in an overpopulated and highly urbanized world.

Sparing effects - the concept that if you can produce more food per unit area, less land is needed for agriculture and can therefore be given over to conservation uses - are often cited as a rationale for promoting Industrial Conventional farming. However, as currently practiced, the adverse effects of effluents from Industrial Conventional systems appear to outweigh the benefits of sparing effects.[7] Strategies to reduce negative impacts include ones that are common to both Organic and Conventional systems, e.g. cycling of wastes between specialized livestock farms and specialized crop farms,[8] and use of constructed wetlands or other types of biofilters to purify effluents. Unfortunately, the GMO issue is proving to be a major point of divergence in strategies. GMO's are fundamentally incompatible with Organic and Ecological systems of agriculture.

Costly high technologies and energy inputs are required to ensure minimal waste in the use of resources and to minimize adverse effects on the environment of Industrial farming, whether Organic or Conventional. In this sense, the ecosystem services that are or could be offered by Industrial systems are ones that we purchase, having displaced the natural systems that would otherwise provide those services free of charge. In contrast, Ecological farming systems maintain many of the natural ecosystem services, and thus offer (a largely unrewarded) benefit to society.

No approach to farming can reverse major losses in biodiversity associated with destruction and fragmentation of natural habitats - the human population is already too large for the sustainability of many other species.[9] However, appropriate management at the landscape level and reduction of toxic effluents from agriculture could do a great deal to conserve what we have for the near future as well as to contribute to ecosystem services.[10]

The framework for Design and Redesign

In Figure 1, I have depicted the design of farm systems as gravitating towards two basic types: toward the industrial pole, a modular, landscape independent design and towards the ecological pole, a mosaic, landscape-integrated design.

The Modular design is one in which individual units maintain a high degree of control over the internal environment and are essentially "landscape independent," i.e., the same design is used regardless of where they are placed. Independence from environment is achieved by saturating the biological response systems, using externally supplied nutrients and control agents as necessary to maintain yields, and in some systems, by controlling temperature, light and moisture. Individual modules are specialized for one or a few products or functions. Hi-tech monitoring and control technologies offer the potential for such systems to be operated with a high degree of efficiency in use of material inputs, and to nearly if not completely eliminate negative environmental impacts exclusive of displacement by the structures themselves (I call this "Techno-protection").

David Patriquin
(photo by Darryl Amey)

Both Conventional and Organic modular systems may employ "biological modules" to purify wastes (e.g. oxidation ponds, solar aquatics, biofiltering of gases); these in turn may produce other products (heat, combustible gases, soil amendments, food or fiber). Design of such systems makes intensive use of science and technology as practiced today and of external expertise. Industrial Organic systems are more demanding of science and technology than Industrial Convention-al systems because of the additional variables involved in predicting responses to organic inputs, and because of more stringent requirements to eliminate contaminants both within the systems and leaving them. For both Organic and Conventional systems, high capital and maintenance costs tend to produce economies by scaling up the size of operations.

The mosaic, landscape-integrated design involves a very different approach. Rather than displace the indigenous systems, diverse farm operations are integrated into the landscape in a mosaic pattern, and are highly dependent on ecosystem services provided both within the farm boundaries, and by adjacent ecosystems. Because of their site specific nature and largely unknown history, mosaic systems are much less amenable to precise scientific analysis and prediction than are modular systems. Aber and Melilo's comments[11] on application of systems analysis to ecosystems are pertinent:

> *"... in human-made systems, all of the subparts can be described clearly because they have been constructed to particular specifications. This is not true of ecosystems. Often the response of individual components are only dimly known for a fairly narrow set of conditions. So systems analysis of ecosystems is not as clean and precise and is always dependent on accurate measurements and studies by field researchers from many disciplines working at many different levels. In that sense, the analysis of ecosystems is more of a continuing set of approximations, hopefully becoming more com-plete and accurate as the information base accumulates."*

How then are Ecological farming systems designed? In practice, this type of design draws heavily on models and practices offered by traditional farming and on holistic concepts, particularly the concept that farming should use natural systems as models.[12] The conceptual models that have emerged for this purpose during the 20th century were chosen for or focused on different aspects of natural system structure and functioning, which is reflected in the terminology used to describe them: e.g. regenerative-, organic-, biological-, biodynamic-, ecological- and nature-farming; permaculture.[13] Most or all have proven to be successful within the context in which they were developed. The resultant farm systems can be very different in the way they are structured and might be considered as "multiple equilibria" or alternative equilibrium states considered characteristic of complex, non-linear systems including ecological systems.[14]

Can these holistic models be considered "scientific"? Smuts regarded holism as non-scientific in itself, but complementary to science.[15] In most cases, scientific interpretations or rationale for these systems of thought, which often incorporate cultural and religious values, can be elaborated, just as biologically adaptive values can be attributed to many traditional belief systems and values. Beyond that, scientific methods, concepts and tools can be used to elaborate the underlying processes in more general terms and make them more readily usable or transferable across different cultural or belief systems. Thus, there has always been a strong effort to incorporate as much science as possible into the precise recommendations and rationale of the certification process.

There is an important further need or function for science and technology in relation to Ecological farming: to analyze existing systems and reveal the potential for improvements in yield and consistency of production that might be archived without substantially increasing inputs or reducing ecosystem protection and ecosystem services.[16] The analysis of farm systems in this context is a type of "ecosystem analysis," which incorporates natural history, experimental, comparative, budgeting and modeling studies.[17] University based research programs are the main venue for this type of science. The 1990s have seen a rapid increase in institutionally based research of this nature.

Because of the high degree of site specificity of processes in Ecological systems, research conducted at institutions, to be usable, must be complemented by studies and trials on individual farms. Thus, a major challenge is to operationalize agroecosystem analysis so that it can be applied at the individual farm level without having to obtain large grants.[18]

Support Services

Industrial systems, whether Organic or Conventional, are highly dependent on external expertise and research in the short term and the long term. In general that need is being met by private enterprise or by private enterprise in collaboration with institutions. Ecological systems are not highly dependent on external expertise in the short term, but have a long term dependence on support services, some of which are best provided by public institutions (e.g. non-proprietary breeding programs), and some that are probably more effectively provided by private enterprise (e.g. soil monitoring). Overall, these needs are not being met. Major needs are for recognition of the role of holistic reasoning in design of Ecological farming systems, operationalizing ecosystems analysis for on-farm use, strategies to promote more integration of crop and livestock farming,[19] and strategies and tools to promote natural selection and genetic conservation at the farm level.[20]

Conclusion

All systems of agriculture practiced today can be seen as having a potential for improvement and contributing toward a more sustainable agriculture. Probably all systems are necessary components of agriculture as long as we maintain our numbers at current levels. However, use of transgenic organisms creates incompatibilities (conflicts) between the different approaches. The major differences in types of services needed to serve the development of Sustainable Agriculture are between Intensive/Industrial and Extensive/Ecological systems rather than between organic and conventional systems (defined by inputs). Support services offered by private and public institutions are adequate for the former, but not for the latter. ✪

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SPEAKER PROFILE

David Patriquin is professor of Biology at Dalhousie University, Nova Scotia. A marine biologist by training, he became interested in organic farming in the 1970s through his work on nitrogen cycling and out of concern about the degradation of aquatic systems associated with industrial farming techniques. Organic farms are system level experiments in ecology, he says, and getting them to realize their full potential for producing food and nurturing the planet is the ultimate test of our understanding of ecology.

He has conducted on-farm research in collaboration with individual farmers and groups of farmers attempting to reduce reliance on agrochemicals or to improve functioning of certified organic farms, and has served as a Certification Agent for several organic farming organizations in the Maritimes and Maine.

HALLMARKS OF SUSTAINABLE FARMING SYSTEMS*

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A new paradigm or model for American agriculture is emerging under the conceptual umbrella of sustainable agriculture. The focus of the concept of sustainability is on intergenerational equity – to meet the needs of the present while leaving equal or better opportunities for the future. In order to fulfill this purpose, sustainable systems must be economically viable, ecologically sound, and socially responsible. Systems of farming that are lacking in any one of these dimensions quite simply are not sustainable over time. Thus, sustainable agriculture requires that farmers find balance and harmony among the economic, social, and ecological dimensions of their farming operations.

Pursuit of Higher Self-interests

Sustainable farmers, like people in general, pursue their self-interest. It's an inherent aspect of being human. But, people, by nature, do not pursue only their narrow, individual self-interest. It's within the fundamental nature of people also to care about other people and to want to take care of the earth. People are perfectly capable of rising above *selfishness and greed* to pursue a *higher* concept of self-interest – a self-interest that values relationships and stewardship as important dimensions of their individual well being.

This *higher* self-interest includes narrow self-interest (which focuses on individual possessions), but it also includes interests that are shared (which focuses on relationships, community, and social values) and interests that are purely altruistic (which focuses on interests one pursues only out of a sense of stewardship, ethics, or morality). All three – self-interests, shared-interests, and altruistic-interests -- contribute to one's well being or quality of life, but not in the same sense that greed might enhance one's material success. Each contributes to a higher sense of quality of life explicitly recognizing that each individual is but a part of the whole of society, which in turn must conform to some higher order or code of natural laws.

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Farmers, in general, presumably would not use chemicals in ways that destroy their health, poison their own food, or pollute their water supply. But, the sustainable farmer must be willing to make ecological investments that will benefit others solely. Sustainability requires that we consider the health and well-being of those down wind and down stream as well as ourselves. Sustainability requires that we conserve non-renewable resources – soil, energy, clean air, and clean water -- for future generations. Thus, ecological sustainability is deeply rooted in a strong sense of stewardship – our responsibility to take care of things for the benefit of others.

Farmers, in general, recognize they must make investments of time and money in family, community and society in general. They may expect personal rewards for these investments, but the rewards must be shared with others. However, some may make social investments for purely selfish reasons – they expect their share of the benefits to exceed their share of the costs. But, sustainable farmers must be willing also to make social investments for purely altruistic reasons – investments from which they expect no direct benefit for themselves. They benefit only from fulfilling their ethical and moral responsibilities to others.

The economic dimension is no less important than are the social and ecological dimensions in ensuring sustainability. A sustainable agriculture requires all three – an agriculture that is ecologically sound, socially responsible, and economically viable. Aldo Leopold, in his essay on land ethics, said we must consider the economics as well as the ethics and aesthetics. We cannot be expected to take care of others unless we are first able to take care of ourselves. Economic viability is necessary if a farmer is to maintain the authority to use the resources for which they are to be good stewards. Or to put it bluntly, if a farmer goes broke, their farming system is not sustainable.

Conflicts arise between economics and sustainability because too often economics are allowed to dominate everything else – including relationships and stewardship. Sustainability requires a measure of profitability, but short run maximization of profit invariably leads to ecological degradation and social exploitation. Sustainability requires balance and harmony among economics, ecology, and community.

The New American Farm

Farming sustainably is no simple task. However, thousands of farmers are finding ways to sustain a desirable quality of life for themselves and to support their local communities while being good stewards of the land and the natural environment. They may carry the label of organic, low-input, alternative, biodynamic, holistic, permaculture, or no label at all, but they are all pursuing common economic, ecological and social goals. By their actions, these farmers are defining a new kind of American farm.

These new American farmers are a diverse group, but they share a common pursuit of a *higher* self-interest. They are seeking sufficient profit for a desirable quality of life. They are building relationships, within families and communities, as well as income, to enhance their overall well being. They are accepting the responsibilities of stewardship, not as constraints to their selfishness, but instead, as opportunities to lead successful lives.

These farmers, these common people, are the architects of the New American Farm. These farmers, not the experts or the scientists, are the ones on the new frontier -- the explorers, the colonists, the revolutionaries, and the builders of a "New World." Life is difficult on the frontier because no one really knows how to do what these folks are trying to do – they are creating the future. They are getting little help from the government, their universities, or the agricultural establishment. They are doing it pretty much on their own. They will continue to confront hardships, frustrations, and there will be some failures along the road. But, more and more of these *new American farmers* are finding ways to succeed.

There are no blueprints for the New American Farm. But a few fundamental principles are beginning to emerge. In general, the new farming opportunities arise directly from exploiting the weaknesses resulting from misuses of industrialization -- specialization, standardization, and centralized decision making. The new American farm relies instead on the advantages of diversity, individuality, and decentralized networks of interdependent decision-makers.

New American farmers focus on working with nature rather than against it. The natural resource base that ultimately must sustain productivity is inherently diverse. Industrial systems have had to *bend* nature -- to augment, supplement, alter, and force it. They had to create an allusion of sameness out of diversity in order to meet the demands of large-scale, industrial production. The ecological problems arising from industrialization are symptoms of natural resources being used in ways that are inherently degrading to their natural productivity. Thus, industrialization has created tremendous opportunities for farmers who learn to utilize the inherently productive capacity of a diverse natural resource base, rather than wasting time and money trying to force nature to conform.

These new American farmers utilize practices such as management intensive grazing, integrated cropping and livestock farming, diverse crop rotations, cover crops, and inter-cropping. They manage their land and labor resources to harvest solar energy, to utilize the productivity of nature, and thus, are able to reduce their reliance on external purchases and inputs. They are able to reduce costs and increase profits while protecting the natural environment and supporting their local communities.

New American farmers focus on value rather than costs. They realize that each of us values things differently, as consumers, because we have different needs and different tastes and preferences. Industrial methods are efficient only if large numbers of us are willing to settle for the same basic goods and services – so they can be mass produced. So, industrialization has to treat us as if we're all pretty much the same. Customers have to be persuaded, coerced, and bribed to buy the same basic things rather than the things they really want. That's why we pay more for packaging and advertising of food than we pay to the farmers who produce the food. The industrial system creates tremendous untapped opportunities for farmers who can tailor their products to conform to unique needs and preferences of individual customers, rather than try to bend the preferences of customers to conform to their products.

New American farmers market in the niches. They market direct to customers through farmers markets, roadside stands, subscription farming or community-shared agricultures (CSAs), home delivery, or by customer pick-up at the farm. They use everything from the Internet to word of mouth to advertise their services. They market to people who care where their food comes from and how it is produced – locally grown, organic, humanely raised, hormone and antibiotic free, etc. They are often able to avoid some or all of the processing, transportation, packaging and marketing costs that make up 80 percent of the total cost of mass marketed foods. They increase value, reduce costs, and increase profits while protecting the environment and helping to build stronger local communities.

New American farmers focus on what *they* can do best. They realize that we are all different -- as producers as well as consumers. We have widely diverse skills, abilities, and aptitudes. Industrialization has had to "bend people" -- train, bribe, and coerce them -- to make people behave as coordinated parts of one big machine rather than as fundamentally different human beings. Many social problems of today are symptoms of people being used by industrial systems in ways that are inherently degrading to our uniquely human productive capacities. Thus, industrialization has left tremendous untapped economic opportunities for farmers and others who can use their unique capacities to be productive rather than attempt to conform to systems of production that just don't fit.

New American farmers may produce grass finished beef, pastured pork, free range or pastured poultry, heirloom varieties of fruits and vegetables, dairy or milk goats, edible flowers, decorative gourds, or dozens of other products that many label as agricultural "alternatives." They find markets for the things they want to grow and are able to grow well rather than produce for markets where they can't compete. Or they may produce fairly common commodities by means that are uniquely suited to their talents. Their products are better, their costs are less, and their life is better because they are doing the things that they do best.

In general, new American farmers focus on creating value through uniqueness -- among consumers, among producers, and within nature. They link people with purpose and place. By linking their unique productive capacities with unique sets of natural resources to serve the needs and wants of unique groups of customers, they create unique *systems of meeting human needs that cannot be industrialized. The more unique their combinations of person, purpose, and place, the more sustainable will be the value to customers and producers alike. The sameness of industrialization creates opportunities for unique farmers who can create unique linkages with both resources and customers.*

Critics argue that these new farm opportunities are limited. On the contrary, there is no limit to the diversity among people nor diversity within nature. There are as many niche markets as there are people. The question is one of how many different markets it is logical to serve, not how many different niche markets exist. Likewise, there are as many differences in production capabilities as there are producers, and as many different niches in nature as there are fields or places to produce.

Some question whether a sufficient number of people who are both willing and able to learn can be found to farm in these new ways. Admittedly, the new American farm will require a lot more knowledge, understanding, and thinking than does farming by industrial standards. However, any future occupation which offers an opportunity for a decent living will require the use of one's mind. The days when someone could earn a good living by the sweat of their brow are in the past. The industrial era is over. There will be plenty of innovative, creative, hard working people to operate the new American farms, once their promise for a more desirable quality of life -- economically, socially, and ethically -- becomes widely known.

Others question whether people can afford to pay farmers the full costs of meeting their food and fiber needs without exploiting either the natural or human resource base for agriculture. However, today's consumer, on average, spends only a dime of each dollar for food -- from which the farmer gets only one penny. Thus, most consumers can afford to pay farmers to produce the food they really want and need rather than settle for something less, particularly if that something less degrades the social and ecological systems from which consumers also must derive their quality of life.

The ultimate strategy for valuing uniqueness is through personal relationships. Each personal relationship is different from all others. Many consumers are alienated from current mass marketing systems not only because they don't meet their specific needs, but because they have lost faith in the impersonal system of mass production for mass markets. They do not believe large corporations monitored by big government will really protect the natural environment or fulfill important social responsibilities. They trust neither corporate or government assurances that foods in the supermarkets are safe and healthful. They feel more personally secure and socially responsible when they support local and regional food systems rather than rely on international markets dominated by the multinational corporations. In other words, they want to know their farmer -- personally.

The most secure markets for the new American farm will be those based on personal relationships. Producers who develop personal relationships with their customers need not see other producers as their competitors. They can collaborate rather than compete. No two people are alike, thus, no two producers are likely to be viewed as close competitors in the minds of their *relationship* customers. Fortunately, meaningful relationships can only be spread so thin. Thus, there will be natural constraints, or limits to growth, in relationship markets. The necessity of maintaining personal relationships offsets the natural tendency to get bigger, and thus, helps farmers to resist the lure of the industrial treadmill. Local and regional markets will be developed and sustained over time by people who prefer to deal with people they know.

Strategies for Sustainability

Sustainable farming might at first seem so complex that few farmers would be willing to accept the challenges of management. However, the trails of this new frontier are being blazed by a host of visionaries who see the emergence of a new post-industrial society, of which managing for sustainability will be but one part. Peter Drucker, the time honored business scholar and consultant to industrial corporations, is among those visionaries.

> *"Every few hundred years in Western history there occurs a sharp transformation. Within a few short decades, society rearranges itself -- its worldview; its basic values; its social and political structure; its arts; its key institutions. Fifty years later, there is a new world.... We are currently living through just such a transformation." (Post-Capitalistic Society, p.210)*

Drucker believes the current transformation began in the early 1970s some 25-plus years ago. If Drucker is on target, we should look to paradigms that have emerged over the past two-to-three decades for clues to the dominant paradigm of the twenty-first century.

Joel Barker, in his book Paradigms, the Business of the Future, claims that new paradigms emerge when it becomes apparent to some people, not necessarily many, that the existing paradigms are not going to be able to solve all the relevant and important problems. Thus, a new paradigm emerges while the old paradigm seems to be doing quite well in the minds of most people. Consequently, new paradigms typically meet with widespread rejection. Therefore, we must look to ideas still being *rejected* by most, but gaining a following, for insights into paradigms of the future.

New paradigms are almost always championed from the *outside* rather than from *within*. Thus, we must be willing to look *outside* rather than *inside* for guidance in pursuit of the new paradigm of sustainability. Some of the visionaries from the outside include Drucker, Toffler, Naisbitt, Hock, Reich, Capra, and others. These visionaries are gaining a following that spans the political spectrum from Hilary Clinton to Newt Gingrich and the business spectrum from Tom Franzen, an Iowa family farmer, to the Dee Hock, the founder of VISA Corporation. Some very practical strategies for sustainability are being outlined by *outsiders* -- include Covey, Savory, Senge, Peters and others.

These pioneers are teaching the day-to-day, nuts-and-bolts process of decision making using paradigms consistent with the emerging paradigm of sustainable agriculture.

The following are but a few examples of readily available sources of uncommon wisdom, based on common sense, that outline very practical strategies for sustainable farming.

Allan Savory's approach to holistic resource management (HRM) is built on a set of four "ecosystem foundation blocks" -- water cycles, mineral cycles, energy flows and succession or community dynamics. These building blocks represent a down-to-earth, practical representation of the *laws of nature* – boundaries of the sustainability paradigm. Savory contends that all *new wealth* is generated by *energy flow* -- the product of the solar chain that transforms solar energy into human-useful forms. The water cycle and mineral cycle are essential elements in this solar chain. The process ultimately is dependent upon biological diversity and community dynamics or biological succession -- processes by which water, air, and minerals are utilized in transforming solar energy.

The three-part, holistic goal of HRM essentially is *sustainability* -- despite Savory's claims that HRM is fundamentally different from sustainable agriculture. The quality of life, production, and future resource dimensions of HRM goals are essentially the same as the social, economic, and ecological dimensions of sustainability. The HRM "whole under management" includes the land base, people, and money -- very practical terms for the ecological, social, and economic resources that must be managed to sustain agriculture over the long run. HRM is far stronger in practical ecology than either the social or economic dimensions. However, HRM recognizes explicitly that things economic, ecological, social are inseparable aspects of the same whole.

Steven Covey's "Seven Habits of Highly Effective People" is a principle-centered approach to life and relationships. Fundamental principles of human relationships are a practical representation of the *law of human nature* – again, boundaries of the sustainability paradigm. Covey claims these natural laws of the human dimension are just as real, and just as unchanging, as laws such as the law of gravity of the physical dimension. He calls them "true north" principles -- not invented by individuals or society, but laws of the universe that pertain to all human relationships and human organizations. These principles surface in the form of values, ideas, norms, and teachings. But unlike values and norms, principles are objective, external, and unchanging – reflecting some higher order of things.

Covey's "Seven Habits of Highly Effective People" may be as good a place as any to start in understanding and teaching the laws of human nature within which a sustainable agriculture must be built. The seven habits begin with developing effective individuals -- (1) Be proactive, (2) Begin with the end in mind, but (3) Put first things first. These habits are designed to move beyond dependence to independence. But the next evolutionary step is to go beyond independence to interdependence -- to move beyond effective individuals to effective *relationships*. Dependent relationships arise out of necessity, but interdependent relationships arise out of choice. To develop effective relationships Covey suggests we must (4) Think win-win, (5) Seek first to understand and then to be understood, and (6) Synergize -- value *interconnectedness*. Finally, success is a process, not an attainment, in that we must continually (7) Sharpen the saw.

Savory and Covey both address organismic approaches to decision making through their emphasis on holistic management, synergism, and interdependence. However, neither goes as far toward developing a practical way of thinking about such issues as does Peter Senge, a MIT business professor and consultant. In his book the, "The Fifth Discipline," Senge proclaims that a new discipline is needed to integrate the other disciplines, to fuse them into a coherent body of theory and practice, to keep them from being separate gimmicks or fads. While his objective may be philosophical, his approach to developing this new discipline is very practical. For example he proposes a set of "laws of systems thinking."

- ☐ Today's problems come from yesterday's "solutions."
- ☐ The harder you push, the harder the system pushes back.
- ☐ Behavior grows better before it grows worse.
- ☐ The easy way out usually leads back in.
- ☐ The cure can be worse than the disease.
- ☐ Faster is slower.
- ☐ Cause and effect are not closely related in time or space.
- ☐ Small changes can produce big results -- but highest leverage areas may be least obvious.
- ☐ You can have your cake and eat it too -- but not all at once.
- ☐ Dividing an elephant in half does not produce two small elephants.
- ☐ There is no blame -- we and our problems are parts of the same system.

One could argue that today's questions of sustainability can be traced to the violation of nearly every one of the ten laws of systems thinking. This would seem to imply that a shift to systems thinking would be a logical approach to answering those questions. Thus, Senge's systems strategies for developing "learning organizations" may provide practical, valuable insights into the strategies needed to manage sustainable systems of farming.

Savory, Covey, and Senge are just three of the more popular authors and educators who are teaching fundamentally new paradigms of personal, professional, and community decision making. All have expanded beyond their original scope of dealing with farm, individual, or business decision making. They all seem to agree that the same paradigm of decision making is both necessary and sufficient at all levels of aggregation, from managing one's personal life to managing the resources of the biosphere. All have rejected mechanical-industrial models and have adopted organismic-sustainable approaches instead. All are based on the *beliefs* that there are limits to growth, that everything is interconnected, and that our decisions must be in harmony with inviolate laws of nature. The beginning texts for understanding and teaching the strategies for sustainable agriculture already have been written. They have been written by Savory, Covey, Senge, and others *outside* of the agricultural mainstream.

The Hallmarks of Sustainable Farming Systems

Some look to farming practices and methods for the hallmarks of sustainable farming – organic farming, management intensive grazing, direct marketing, integrated crop and livestock systems, crop rotations, etc. However, these are but the means by which farmers practice the principles of sustainability. The hallmarks of sustainable farming strategies underlying these farming methods are diversification, individualization, and decentralization of decision making within interdependent networks. Sustainable farmers work with nature, they focus on value, they market in the niches. They value their uniqueness as individuals and the uniqueness of their relationships with others. Sustainable systems match unique farming operations to the uniqueness of the farmers, their potential markets, and the natural resources of their farm. The farming practices and methods of a sustainable farming system are unique to the farmer, the farm, the market, and the community.

Sustainable farmers are linked by their common commitment to the principles of sustainability. Intergenerational equity is the overarching hallmark of sustainability – meeting the needs of the present while leaving equal or better opportunities for the future. The hallmarks derived from intergenerational equity, are economic viability, ecological soundness, and social responsibility – all interdependent dimensions of the same whole. Thus, holistic management is a hallmark of sustainable farming -- balancing economic, ecological, and social objectives – in harmony with some higher order of things. The laws of nature, including human nature, provide the bounds within which decisions must be made. Sustainable farmers consider the environment and community, as well as economics, in every decision they make. Guided by a *higher self interest* sustainable farmers build relationships and practice stewardship, neither for economic gain nor personal sacrifice, but instead to enhance their overall quality of life. The principle hallmark of sustainable farming is the pursuit of a *higher* quality of life -- for farmers, their families, their communities, and for all people, both now and in the future. ✪

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SPEAKER PROFILE

John Ikerd was raised on a small dairy farm in southwest Missouri and educated at the University of Missouri with BS, MS, and PhD degrees in Agricultural Economics. He was employed for three years with Wilson Foods in Kansas City, MO, Atlanta, GA, and Detroit, MI between BS and MS degree work. Dr. Ikerd worked in Extension Agricultural Economics positions at North Carolina State University (1970-76) and Oklahoma State University (1976-84) and was Head of Extension Agricultural Economics, University of Georgia (1984-89). In 1989 he returned to the University of Missouri under a cooperative agreement with the USDA, to provide state and national leadership for research and education programs related to sustainable agriculture. He retired and received appointment as Professor Emeritus of Agricultural Economics on February 1, 2000.

His work included National Sustainable Agriculture Projects with the USDA SARE Program, the development of Farm Decision Supports Systems for Sustainable Agriculture (PLANETOR), Sustainable Agriculture Education Council (SA Professional Development Program), Addressing the Quality of Life Dimension of Sustainable Agriculture, Regional Liaison-South and Northeast- SA Professional Development Program, and State Co-coordinator of SA Professional Development Program for Missouri.

Since retiring from the University in early 2000, Ikerd spends most of his time writing and speaking out on issues related to sustainable agriculture with an emphasis on the economics of sustainabilty. In addition, he continues as the project leader for a three-state, five-year program, with funds from the W.K. Kellogg Foundation, which links sustainable agriculture and sustainable rural community development. Dr. Ikerd plans to continue writing and speaking out on economic and sustainability issues into the foreseeable future.

ORGANIC FARMING AND SUSTAINABLE AGRICULTURE

— MARY A. BECKIE —

Throughout the past few years, I have spent a considerable amount of time investigating the different ways in which sustainable agriculture has been conceptualized and how it is being implemented in Saskatchewan. As part of my recently completed Ph.D. project, I examined organic farming as both a practical and theoretical response to sustainable agriculture. I grounded this study at the farm-level by examining 33 organic farming systems located throughout the seven soil climatic zones of southern Saskatchewan.

The findings from this and other research indicate that organic agriculture offers relatively important contributions to the development of sustainable agriculture. At the local level, there are economic, environmental and social benefits for both farmers and rural communities. Organic agriculture is also playing an increasingly prominent role in the global agri-food system. It is now the fastest growing sector in agriculture. It is also part of a global social movement, where concerns about health, food quality and food safety, land use, and social justice are being integrated in an analysis of the challenges facing agriculture. This social movement and this sector of the consumer base are influencing changes in the food system, and in how we think about and approach sustainability.

In Canada, research on sustainable agriculture within federal and provincial agricultural institutions has been focused on economic and scientific analysis of farming practices. Quantitative investigations of productivity, profitability, and selected environmental parameters are used to compare the sustainability of farming systems. These parameters are useful indicators. But in this approach the social dimensions of sustainability have been neglected, which are equally important and strongly linked to ecological and economic variables. As a result, some important issues in Saskatchewan agriculture have not been well examined, such as the impacts of farming practices and agricultural technologies on human health, family farms and rural communities, and the importance of diversity of knowledge, skills and approaches to sustainability.

My goal today is to illustrate how organic farming contributes to the development of sustainable agriculture, by looking beyond productivity and profitability, to other equally meaningful and important dimensions of sustainability.

1. Introduction to Organic Farming:

a) definition, goal, key characteristic

Organic farming is defined as "an approach to agriculture where the aim is to create integrated, humane, environmentally and economically sustainable agricultural production systems, which maximize reliance on farm-derived renewable resources and the management of ecological and biological processes and interactions, so as to provide acceptable levels of crop, livestock and human nutrition, protection from pests and diseases and an appropriate return to the human and other resources employed" (Lampkin 1994: 4).

The term "organic," in this usage, does not refer to the type of inputs used or the avoidance of certain synthetic compounds; it literally means "parts integrated into a whole organism" (Clancy and Kirchenmann 1999).

The farming system is conceptualized as an organism, in which all the component parts - the soil minerals, organic matter, micoorganisms, insects, plants, and humans – interact to create a coherent whole.

The goal of organic farming is to sustain the integrity of the whole farming system.

The key characteristic distinguishing organic farming from other approaches to sustainability is the existence of both legislated and voluntary standards and certification procedures.

b) Production and Marketing Trends

Organic agriculture originated in the 1920s in Europe. Until the late 1960s, it was largely disregarded by most of the agricultural community and society in general as unscientific or regressive.

During the 1970s and 1980s, there was a renewed interest in organic agriculture by farmers and consumers. Organic regulations and symbols began to be established nationally and internationally.

In the early 1970s a small number of farmers in Saskatchewan began farming organically. These farmers turned to organic production in response to problems they identified in conventional agriculture including:

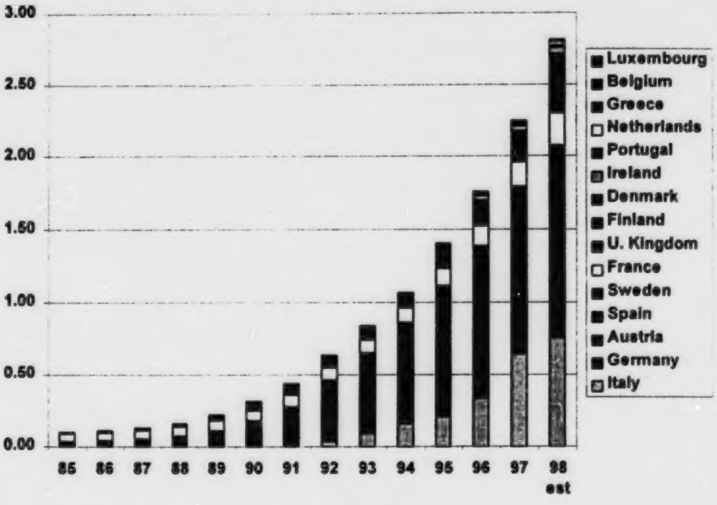
- declining soil quality and other environmental impacts,
- the high and rising cost of production relative to commodity prices,
- health risks for farmers and consumers associated with increased use of agrochemicals,
- increasing consolidation resulting in declining number of farmers and rural communities.

During the 1990s, organic agriculture became the fastest growing sector of the global food system and demand continues to exceed supply.

The EU is the world's leading market for organic food, representing approximately 4 % of its total food sales. In North America, close to 2 % of the total food sales is organic, with a 20 % rate of increase per year.

Market surveys indicate that most of the demand for organic food is from relatively young individuals and families in large urban centers with above average incomes. This increasing demand is driven by changes in eating habits, as consumers are putting greater emphasis on healthy, nutritious and safe foods, as well as strong and growing support for the development of an environmentally and socially sustainable agricultural system.

Growth of Organic Farming in the EU 1985 - 1998



(million hectares)

Rapid increases in organic production have taken place in the EU during the past 15 years. Several countries (e.g. Denmark, Sweden, Switzerland, Austria and Germany) have introduced financial incentives to encourage farmers to make the transition to organic agriculture. This support has contributed to the rapid expansion of organic production in these countries in recent years.

Despite the increase in production in the EU there continues to be strong demand for high quality organic cereals and grains from the Canadian Prairie. The Europeans view this region as a relatively unpolluted environment, compared to other industrialized countries, and therefore an ideal source of organic food.

Until recently, there has been relatively little institutional support for organic agriculture in Canada. For most farmers, learning has occurred through various informal means, including their own on-farm trials, learning from other farmers, and information gathered from the alternative agriculture press and certification and marketing organizations. This situation limited the growth of the organic industry in Saskatchewan from the 1970s through to the mid 1990s.

During the past few years, the organic industry in Saskatchewan has been experiencing increased growth, which can be attributed to the current economic advantages of organic agriculture (which I will discuss in more detail later), and increased interest and support by both government agencies and agribusiness.

In a 1996 national survey, Saskatchewan had the second highest provincial number of organic farmers, and the fastest rate of adoption in Canada. At this time, there were approximately 380 certified growers and 241,000 certified acres in the Province.

In the 1999 crop year there were 590 fully certified producers and 240 in transition (total 830) in the Province. Most of the certification agencies expect their membership to double this year, based on the number of inquiries.

Most organic farms in the Province concentrate on commercial-scale production of organic cereals, pulses and oilseed crops. As well, there are a significant number of mixed crop and livestock operations and a few organic producers growing horticultural crops.

In most regions of the world, organic production is associated with relatively small-scale diversified operations. Organic farmers in Saskatchewan have become world-leaders in adapting the organic approach to large-scale production in an area of relatively high agricultural risk. Successful organic farming systems can be found throughout the different soil climatic zones in the Province.

2. Environmental, Economic and Social Benefits of Organic Farming

The information I will present on the environmental, economic and social benefits of organic farming is based on general findings from comparative studies of farming systems. Most of these studies compare organic with conventional farms; in my study, organic farms were compared with zero tillage farms. If anyone is interested in the references used, I can provide these upon request. The benefits I identify here may not apply to all organic farming systems, as there is a great deal of heterogeneity among organic farms and among all types of farming systems. But this is meant to provide a brief introduction to the benefits of a well-developed organic system.

Environmental Benefits:

1) Soil Quality:

By utilizing a variety of biological and cultural practices, both farmers and researchers have found organic farming can result in improved soil quality, including increased soil organic matter and soil tilth, and decreased erodibility.

These practices include:

a) Diversified and extended crop rotations: organic farmers grow a wide range of conventional and specialty crops, and have minimized the use of summerfallowing and intensive cultivation.

In my study, 45 % grew 7-11 crops in rotation. A 4 year rotation was most common. About 2/3 of the farms used summer-fallowing to end a rotation, and 1/3 replaced summer-fallowing with a legume green manure crop that is cut and worked under in late June or early July.

b) Incorporation of legumes and other plough-down crops (e.g., buckwheat, fall rye) in rotation to increase soil nitrogen, organic matter, and accessibility to soil phosphorus. The use of alleopathic crops in rotation are also used in weed control.

c) Nutrient recycling: application of com-posted animal manure and crop residues.

References:Beckie 2000, Bird et al. 1995, Brandt et al. 1998, Clancy et al. 1993, Gameda et al. 1998, Rutherford et al. 1992, Smolik et al. 1993, Painter et al. 1995, Reganold et al. 1987.

2) Due to the elimination of synthetically manufactured pesticides and fertilizers, the risks associated with agrochemical contaminants to soil and water quality, and therefore human and wildlife populations, are lowered in organic systems.

- There is growing evidence that certain agrochemical contaminants negatively impact on eco-systems (local and distant) and on human health.

From 1981 to 1996, the use of agrochemicals increased by approximately 50% in Saskatchewan (Statistics Canada 1997). This increase is contrary to the overall trend in Canada and throughout many industrialized nations. Although application rates still tend to be relatively low in Saskatchewan, more than 80 % of all the herbicides used in Canada are applied to the large agricultural area on the Prairies.

References: McDuffie et al. 1995, Norstrom et al. 1998, Pimental et al. 1992.

3) Organic farming emphasizes biological diversity (crops and livestock) and the use of a diverse range of weed control methods, both of which are beneficial to improved management of pest populations.

- As reliance on pesticides has intensified in Saskatchewan the occurrence of resistant weeds and insects has also increased. Many experts would agree that the only effective way to combat resistance is to reduce the use of pesticides.

References: Beckie 2000, Morrison and Devine 1993, Moss and Rubin 1993.

4) By eliminating synthetic nitrogen fertilizers, organic agriculture contributes to the reduced use of fossil fuels and subsequent carbon dioxide emissions.

Agriculture in Saskatchewan is highly dependent on fossil fuels as an energy source. In addition to contributing to the depletion of a non-renewable energy source, the use of fossil fuels also contributes to carbon dioxide emissions that impact on global climate.

One of the most energy intensive aspects of Prairie agriculture is the reliance on manufactured nitrogen fertilizers.

- Organic agriculture avoids this high-energy cost by using legumes in rotation to fix atmospheric nitrogen and by recycling nitrogen in animal manure.

Reference: Cacek 1984.

5) Organic farming can be practiced in all the soil zones of Saskatchewan.

Reference: Beckie 2000

Economic Benefits:

1) According to Lampkin and Padel, input costs can be expected to drop by 20-60 %, depending on the type of farming operation.
    - This reduction is mainly due to the elimination of synthetically produced agrochemicals, but farmers in my study also claimed to be saving money by not having to be dependent on the latest developments in machinery, equipment, and other technologies.
2) Prices of organic products fluctuate, depending on conventional prices and market demand, but generally range from 30 to 300 percent above conventional prices. Given the current economic crisis in farm income, organic prices constitutes significant economic advantages for farmers.

References for 1) and 2): (Hanson et al. 1997, Lampkin and Padel 1994, Rutherford et al. 1992, Stanhill 1990, Smolik et al. 1993)

3) Organic farming is a scale-neutral approach, meaning it is an economically viable option for small- to large-scale operations.

A relatively small-scale organic farm growing high value specialty crops, and with additional diversification in processing and marketing, could generate the same or a higher gross income than a large-scale grain operation.

References: Fowler and Lampkin 1999

4) Organic farming is suitable for either crop or livestock production, and ideally suited to mixed operations due to the potential for nutrient recycling.

References: Beckie 2000, Lampkin 1994

5) Diversified organic farming systems enable economies of scope (economic advantages associated with greater diversity, as opposed to the economies of scale associated with specialized production systems):
    - Greater income stability than specialized farming systems. Risk associated with crop failure or rapid shifts in market trends is lower.

- More even distribution of labour demands, production costs, and income throughout the year.
- By reorganizing labour and management, organic farmers have been able to diversify into processing and marketing.
- fuller use of on-farm resources: labour, land and nutrients.

References: Beckie 2000.

Social Benefits:

In general, organic farms in Saskatchewan and throughout the Northern Great Plains are classified as relatively diversified and of moderate size.

1) Both the number and diversity of farms have been shown to be positively correlated with cultural diversity, employment, and business opportunities in rural regions.

References: Beckie 2000, Bird et al. 1995, Buttimer 1998, Klemme 1991.

2) Due to the requirements of organic certification, organic management is generally associated with a long-term commitment. Studies have shown that organic farmers own a high proportion of the land they farm, as opposed to renting or leasing.

   - Ownership of land has been positively correlated with land stewardship.

References: Beckie 2000, Clancy et al. 1993, Lockeretz and Madden 1987.

3) General characteristics identified for organic farmers in my study suggest that organic farming can generate relatively important contributions to social capital in their communities:

   - a high degree of involvement in community and agricultural organizations
   - a greater reliance on labour exchange with relatives and neighbours, than on hired non-family labour
   - reliance on personal experience and sharing information with other farmers, thus contributing to the creation of local knowledge and skills, and building farmer networks.

References: Bateman 1994, Beckie 2000, Buttimer 1998, Flora 1995, Phillips and Gray 1995.

Summary and Conclusions:

- In summary, it has been shown that organic farming can be a profitable and resource-conserving approach to farming.
- Given the social and economic benefits outlined, organic farming can be seen as a valuable strategy for sustaining diversified family farms and rural communities.
- In this province, there has been an emphasis within agricultural institutions on high external input approaches, such as zero tillage, precision farming, biotechnology and intensive livestock operations as solutions to sustainability.

We need to foster a greater diversity of approaches to farming, particularly low external input alternatives such as organic farming.

Diversity is key to sustainability given the variability of local ecological, social and economic factors. But diversity is also important because it presents a wide range of responses and potential solutions to the challenges in agriculture. By supporting a diversity of approaches, we retain the capacity to be flexible and respond to change.

When we work with complex systems, as in agriculture, we must recognize that there is never a simple solution to a problem. And every solution brings with it a new set of problems. We need to acknowledge this and work to improve all useful options for sustainability.

As agricultural production is being increasingly drawn into the global economy, local and global factors are drawn closer together.

As a broader range of issues and perspectives are brought into the discussion over sustainability, organic agriculture can be expected to play an increasingly prominent role in shaping how we think about and approach sustainability.

Note to Soil Quality:

Problems:

Soil erosion and its impact on soil quality are potential problems for organic farmers on the Prairie, as most continue to rely on tillage and summerfallowing for weed control. However, several studies carried out throughout the Northern Great Plains indicate that many organic farmers recognize the problems associated with intensive and frequent tillage and are reducing reliance on these practices by using the above practices, as well as incorporating alleopathic crops in rotation (e.g. Rye, buckwheat, clover).

Soil fertility: In 1992, Rutherford et al. reported soil phosphorus levels to be below recommended levels on the 34 organic farms they studied over a 3 year period. Rock phosphate can be used in organic systems, and phosphorus can also be recycled from animal manure. The use of legumes and other crops in rotation makes soil phosphorus more available. ✪

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SPEAKER PROFILE

Mary Beckie grew up on a farm in south central Saskatchewan, back in the days when you could easily walk to the neighbours' farm, in any direction, and when farmers' raised most of the food their families ate. In this setting, she developed a deep respect and appreciation of farmers, rural communities, and the complexities and beauty of nature. T She has ten years experience working with Saskatchewan organic producers and organic and sustainable agricultural organizations in Canada and the mid-west United States.

She studied biology, molecular menetics, and agricultural biotechnology and did her B.Sc. 1977 in biology: genetics and botany at Dalhousie University and the University of Saskatchewan. In 1987 she completed her M.Sc. at the Western College of Veterinary Medicine, University of Saskatchewan and her Ph.D. in Agriculture and Agricultural Extension at the University of Saskatchewan in 2000. The title of her thesis is: "Zero Tillage and Organic Farming in Saskatchewan: An Interdisciplinary Study of the Development of Sustainable Agriculture".

Dr. Beckie's current focus is on organic farming systems research and extension.

WORKING WITH PROCESSES OF CHANGE, PARTICULARLY PSYCHOLOGICAL PROCESSES, WHEN IMPLEMENTING SUSTAINABLE AGRICULTURE

— PROFESSOR STUART B. HILL —

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RICHMOND, NSW, AUSTRALIA 1999

It is common for proposals for change, which usually imply criticism of current practices, to bring up fear and a diverse range of defensive behaviours. These extend from withdrawal, non-compliance and argument to ridicule, angry confrontation and even violence. Attempts to deal with this usually focus on strengthening the case for change, often by doing more research, and seeking legal and political solutions. While these initiatives are often essential components of the change process, they fail to address the psychological and emotional barriers to change. These have their roots in personal histories, particularly during childhood, of having to adapt repeatedly to disempowering experiences such as abandonment, rejection, ridicule and lack of respect.

This adaptive process usually results in loss of access to one's potential, lowering and narrowing of awareness, loss of creativity and vision, confusion concerning values, and the development of numerous compensatory behaviours. These latter are so common in our societies that they are widely regarded by many as the norm. These behaviours include a wide range of consumptive, stimulatory and distractive activities, as well as attraction to symbols and illusions of power and control. This is partly achieved by owning impressive properties, powerful machines, the simplification of designs (such as monocultures) and processes, division of the world into resources and enemies, and the excessive use of overkill solutions to control and eliminate the latter. The seeking of positions of power within hierarchical organisations is also part of this compensatory process. So, paradoxically, many of our so-called leaders and public figures are disempowered individuals who are attracted (largely subconsciously) to such positions to compensate for their internal sense of powerlessness. Such an understanding makes their common lack of genuine leadership no longer a puzzle.

In a study of health in the UK it was found that over 60% of all behaviours are of this compensatory, adaptive nature (Stallibrass 1989, Williamson & Pearce 1980). With such behaviours as the dominant way of being in the world it is not surprising that we have largely designed adaptive political, religious, economic, work, welfare and recreational structures and processes to support our compensatory demands. It is also not surprising that most efforts to reform these are resisted, and when 'successful' result only in temporary or very minor change.

With this understanding it is also no longer a puzzle as to why it has been so difficult to develop and implement genuinely sustainable systems of food production, handling and consumption.

To bring about such change requires better models and maps of the processes involved (Hill 1998, 1999, in press a, b, c). These need to include programs of action that build on and integrate understandings within the personal, socio-cultural and environmental domains. We need to know more about how individuals, groups and ecosystems function, and how they relate to one another in the processes of health and wellness creation and maintenance. Also, we need to have a better understanding of our psychosocial history (deMause 1982), of our coevolutionary potential (Norgaard 1994) and of the processes involved in benign change (Beck & Cowan 1996, Heron 1996, Hunter et al 1997, Lewin 1935, Peavey 1994, Rowan 1993). And we particularly need to revise our ideas about child rearing (Sazanna 1999, Solter 1989, Stellibrass 1989) and about the importance of forming mutualistic relationships (Josselson 1996, Shem & Surrey 1998). With respect to child rearing, I believe that it is particularly important to foster the development of autonomy, mutualistic relationships and a sense of place (Hill in press c).

One framework for understanding the psychological structures and processes involved in change

Most psychotherapies are explicitly or implicitly based on a 'model' of each of us having a 'true,' essential or core self that can be spontaneous, autonomous and experience mutualistic and caring relationships with one another and with place. The model also assumes that we have a range of adaptive, distressed, patterned selves (or expressions of self) that are what we have had to become at various times to survive often repeated external insults. In this adaptive process we give up our consciousness and ability to live proactively -- from the inside out -- and we increasingly become expert at living primarily responsively and often fearfully -- from the outside in. In such a state we are extremely vulnerable to manipulation, colonisation and also violence; and we tend to do to others what has been, and is being, done to us. This constitutes our 'negative' cultural inheritance ('meme': Dawkins 1989), and it undermines our 'positive' cultural inheritance.

> *...morality does not exist on the deeper levels of human existence... [only] when individuals have lost their internal access...[to] feelings...moral principals must be invoked time and again ... accompanied by a variety of real and imagined punishments in order to counteract natural feelings and impulses...Thus, when one is allowed [one's] feelings, morality vanishes....Feeling people cannot harm others....because they can feel, they experience the impact of their every act...[they] have no need to be immoral...[to] want more than they need....We have been observing neurosis with its attendant immoral behaviours for so long that we have come to accept lose living as the nature of things. It is only when we finally get [in touch with our] feelings that we see what pure, honest and moral souls [we are].* (Janov & Holden 1975, p.269-70).

> *a* MEME *(or values-attracting meta-meme) reflects a world view, a valuing system, a level of psychological existence, a belief structure, an organising principle, a way of thinking or a mode of adjustment. It represents...a core intelligence that forms systems and directs human behaviour....it impacts upon all life choices as a decision-making framework....[it] can manifest itself in both healthy and unhealthy forms...[it provides a]...structure for thinking, not just a set of ideas, values or cause...[and] it can brighten and dim as the Life Conditions (consisting of historic Times, geographic Place, existential Problems, and societal Circumstances) change.* (abstracted by R. Lessem in the Introduction to "Spiral Dynamics" by Beck & Cowan 1996, pp. 4-5)

Although I am presenting these ideas in a dualistic way, I am aware both of the dangers of dualistic thinking and that the processes that determine our behaviour are undoubtedly much more complex. Nevertheless, I believe that the model I am describing can still help us to think creatively and responsibly about the issues being discussed here.

In the book 'Alternative Futures for Prairie Agricultural Communities,' I traced two contrasting ways of designing and managing agroecosystems -- conventionally and ecologically -- back to their possible roots in these two expressions of the self, and to their collective manifestations in our institutional structures and processes (Hill 1991, Fig.4). Similar analyses could be done for our political systems, economic systems, technologies, religions, and even our psychotherapies. Our multiple selves (core plus adaptive selves) have very different interests, priorities, values, and ways of relating to others, to place and to problems (Hill 1998, Table 4). Predictably the cost of maintaining these different selves, based on their associated resource requirements and personal, social and environmental impacts, may often differ by orders of magnitude. Because our core selves have no need for compensatory consumption or for impressing others they are likely to be both less expensive to maintain and more effective and efficient. As we are all made up of these multiple selves, it should not surprise us that much of our lives have a grey and contradictory quality, this being the result of our various selves constantly competing for centre stage. Because of this psychological complexity it is impossible to accurately identify the specific roots of any observed action. Yet the implications of this psychological understanding are clear. There would be enormous benefits, personally, socially and environmentally, from doing whatever it takes to live as much as we can from the core self end of our psychological spectrum.

Lest it be assumed that I am unaware of the social aspects of the problematique I have been discussing, let me say a word about that. I am certainly not implying that 'to change the world' all that is required is for each of us to reconnect more with our core selves. Such connected individuals would still be stuck with having to live within cultures that are often largely the product of adapted selves. These cultures are characterised by compensation, oppression, regulation, judgement, fragmentation, exclusion, hierarchy, and adversarial and uncaring relationships. Acting in contradiction to these 'norms' alone, or even as a member of a mutually supportive group, may still result in marginalisation, ridicule, persecution and, in some societies, even death. Various thresholds of 'enough active core selves' and 'enough mutualistic relationships' have to be reached to start to be effective in deconstructing and redesigning our various maladaptive institutional structures and processes.

The primary barrier to the development of autonomy, mutuality and a sense of place in children is that those who influence us, particularly our parents, and the environments in which we live, are adapted and designed, respectively, largely to accommodate both a loss of these three qualities and to regard a comprehensive range of compensatory behaviours, and their supportive social structure and processes, as 'normal.' To put this another way, it is difficult to give what one has not received, does not have or is unfamiliar with. Our common inability to pay loving attention to children while they cry and recover from their hurts -- the crying being a necessary part of their healing process -- illustrates this point. The deprivation of such opportunities for recovery leaves residues of unhealed hurts in our subconscious, which is uncontrollably awakened by the sound of a child's cry. It is predictable that we would try to stop children crying, driven by our subconscious, which is protecting us from painful memories (an adaptive response), while we consciously reason that we have solved the hurt problem by stopping the crying (Solter 1984, 1989). This is just one example of numerous similar adaptive patterns of behaviour that, in the face of crises, get established as solutions that are beneficial in the short-term, but that have considerable, largely hidden, long-term personal, social and environmental costs. A parallel process to this at the physiological level has been labelled by some in the field of environmental medicine as the 'adaptation, addiction, allergy, degeneration syndrome' (e.g., Rea 1992-95). When our potentially beneficial and needed capacity to adapt in the short term, becomes overloaded, it results over the longer term in maladaptations, which may eventually result in chronic fatigue, isolation, severe depression or other expressions of system overload and degeneration.

At one time or another, most of us feel some degree of emptiness, loneliness, inadequacy, idealism, or spiritual longing. We recognise the ... desire to escape pain, and ... seek answers in activities, substances, or relationships (p.12). The irony is, no external activities or substances satisfy the initial craving or the feeling of emptiness (p.14). This intense and at times painful craving is deep thirst for our own wholeness, our spiritual identity ... or core (p.15) ... this fervent thirst for wholeness, as well as the discomfort with it, is the underlying impulse behind addictions (p.17). (Grof 1993).

I have mentioned the above examples of children crying and system breakdown to acknowledge how challenging it is for most of us to think clearly about what might actually be required to develop a framework for understanding and for supporting the development of autonomy and sense a place in children. I believe that the framework recently proposed by Ruthellen Josselson (1996) for the development of 'relationship competencies' can also be used to deepen our understanding of the development of autonomy, mutualism and sense of place. Based on an extensive review of the literature, Josselson recognises eight overlapping and mutually supportive processes, four that are sensory grounded (holding, attachment, passionate experience, and eye-to-eye validation), and four that are cognitive (identification and idealisation, mutuality and resonance, embeddedness, and tending and caring).

Applying this psychological understanding to working with farmers, and others, in the transition to sustainable agriculture

Usually change agents are over-eager to quickly firm up plans and implement actions. Behind plans and designs are ideas and visions, and behind these are loves, passions and feelings, all of these existing within a context of one's worldviews, values and beliefs. Thus, as change agents, rather than rushing to discuss plans and actions, it is more effective to start by opening up a space to talk about these 'background' influencing factors, where often, greater agreement can be reached. Also, appreciation of the diverse positions within the group is a valuable pre-requisite to subsequent effective planning and action.

My experience of working in this way has been one of repeatedly being amazed as I listened to farmers talking about their deep love of the soil, the wonders of nature, and of mateship and community.

Thus, when working as a facilitator with farmers, and with other groups interested in improving situations, I start by opening up a space for participants to share their passions, interests, fears and hopes. Gradually an agreed upon focus for that particular meeting emerges - perhaps better soil or pest management, bush regeneration or windbreak and wildlife corridor design - and my first question (as a go-round) is 'what have you already done towards making progress in this area?' My experience is that most change agents are so eager to inflict their ideas on others that they neglect to check what the present level of understanding and competence is, and what has already been done, and, even more important, they fail to acknowledge and celebrate the latter.

By sharing these *first steps*, participants have opportunities to connect with others with similar interests, and a context is created in which they automatically start to think what their next steps might be; and, in fact, this is my next question.

Usually, again, connections are made across the group, particularly offers of and requests for help. Such very basic community building processes considerably increase the chances that any plans we come up with will actually be implemented. One can then use a combination of Lewin's (1935) *force field analysis* and Fran Peavey's (1994) *strategic questioning* to see what the resources and supports needed, and barriers, are to taking these next steps; and to see how these might be addressed - as Peavey says, 'what will it take for you to actually do this?'

Because we live in a culture that over-values *Olympic* scale initiatives, which are impossible for most of us to be involved in, we should make a special effort to emphasise the importance of *small, meaningful projects that one can guarantee to carry through to completion*. Indeed, I put forward the fairly revolutionary idea that by celebrating these publicly (for example, through the local media and social gatherings) they are likely to be copied by others and paradoxically be much more likely to bring about positive sustainable change in society than the mega-projects that currently attract most efforts and resources. These latter rarely deliver on their promises, often have unexpected harmful sideeffects, generally undermine community participation and ownership, invariably give a poor return on investment, and are often unsustainable. Classic examples are the building of large dams versus small dams together with integrated, community-based water management programs; and the widespread spraying of biocides or release of biological controls versus the creative local redesign of agroecosystems to make them less favourable for the offending pests and more favourable for the crops and their natural controls (Hill 1990).

The next step in the facilitation process is to help clarify the actions that will be taken, identify who will support whom (to contradict another dominant message in our society that 'you have to do it alone') and re-frame these actions as 'commitments' (contracts with oneself and the group) with specified outcomes and time frames. When we get together again, in a month for example, we check what has been done, and acknowledge and celebrate it, and identify what were the barriers for whatever was not done and see how these can be addressed; and then we go through the cycle again. Usually there is a high level of participation, commitment and follow-through when employing this approach. It is both enjoyable and productive -- and it has important side-benefits such as community building and meaning making for the individuals involved.

Conclusions

As a result of doing this sort of work over the past twenty years I have found that the initiatives that are taken tend to evolve from strategies that focus on *efficiency* (for example, more accurate and controlled uses of inputs and minimisation of waste) to *substitution* (for example, from more to less disruptive interventions, such as from biocides to more specific biological controls and other more benign alternatives) to *redesign* -- fundamental changes in the design and management of the operation. Examples include the design of complex crop rotations and the use of inter-crops and planned field borders, rotational grazing, composting and solar, renewable resource based energy systems and the more radical design of information-rich, multi-storey polyculture systems. This progression generally involves a shift in the nature of one's dependence -- from relying primarily on universal, purchased, imported, technology-based interventions to more locally specific and available knowledge and skill-based ones. This usually eventually also involves fundamental shifts in world-views, senses of meaning, and associated lifestyles (Hill 1991). My experience is that although efficiency and substitution initiatives can make significant contributions to sustainability over the short term, much greater long-term improvements can only be achieved by redesign strategies; and, furthermore, that steps need to be taken at the outset to ensure that efficiency and substitution strategies can serve as stepping stones and not barriers to redesign ones. The institutional implication for supporting such changes have been discussed more extensively in previous publications (MacRae *et al*. 1989, 1989a, 1990, 1993; Hill & MacRae 1995).

Using the approach advocated here with Quebec farmers interested in adopting more sustainable systems of farm design and management led to much higher rates of change than had been achieved elsewhere using the more conventional top down approaches (Hill & MacRae 1992).

People often ask me if I am optimistic or pessimistic about the future. I am definitely optimistic, partly because this is my nature and because we have only just begun to take the sorts of initiatives that I have described above and I think that as we do, significant improvements will follow. Let us not waste this extraordinary opportunity. ✪

Stuart Hill
(photo by Darryl Amey)

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SPEAKER PROFILE

***Professor Stuart B. Hill** was appointed Foundation Chair of Social Ecology at the University of Western Sydney (Hawkesbury Campus) in 1996. Prior to that he had been at McGill University, in Montreal, Canada, where he had coordinated McGill's zoology major, and established, in 1974, Ecological Agriculture Projects (http://www.eap.mcgill.ca), Canada's leading resource centre for sustainable agriculture. He has published over 280 papers and reports, and in Canada was a member of over 30 regional, national and international boards and committees, and he is currently on the editorial board of four refereed journals. He has successfully completed projects in the West Indies, French West Africa, Indonesia, The Philippines, and the Seychelles, as well as in Canada and Australia.*

Dr. Hill is committed to working for change that improves ecological sustainability, and community and personal wellbeing, and our psychosocial coevolution. He is critical of the still dominant tinkering (shallow) responses to problems, as well as their endless measurement, and is a tireless campaigner for the pro-active, fundamental (deep) redesign of our lifestyles, our institutional structures and processes, our managed ecosystems and our technologies. His background in ecology, soil biology, entomology, agriculture, psychotherapy, education, policy development and international development, and his experience of working with change, have enabled him to be an effective facilitator in complex situations that demand both collaboration across difference and a long-term evolutionary approach to situation improvement. As this is a focus of social ecology, he is currently in an euphoric state as a member of a dynamic learning and action community (of over 300 staff and students) with overlapping values and mutually supportive projects. Enquiries about Hawkesbury's Social Ecology programs should be directed to Kathy Adam, Faculty of Social Inquiry, UWS-H, Locked Bag No. 1, Richmond, NSW. 2753. Phone: 02 4570 1288. E-mail: k.adam@uws.edu.au.

ACHIEVING AGRICULTURAL SUSTAINABILITY IN AUSTRALIA BY 2020: A SOCIAL ECOLOGY FRAMEWORK

— PROFESSOR STUART B. HILL —

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RICHMOND, NSW, AUSTRALIA 1999

What an exciting prospect, a whole country in which all managed ecosystems (gardens, farms, forests, parks, etc.) are designed and managed to promote personal, social and ecological health. A country in which the literacy and competence in each of these areas among the whole population is such that curative approaches to problems are only resorted to in emergencies. A country in which all the people characteristically choose to act on love over fear, caring and responsibility over alienation and apathy, and who have discovered how to live spontaneously and creatively in the moment, taking into account lessons from the past and collective life affirming visions for the future. Food would be produced, distributed and consumed primarily for nourishment and celebration (the end of most of the centre isles in the supermarkets!). Extension agents would be experts in ecosystem design and detection of early indicators of change. Educational programs would build on a solid foundation of personal, socio-cultural and ecological understandings. This would provide a basis for developing competency in working with others to vision, design (and revision and redesign), implement, manage and monitor systems. Many consumers would be part of community supported agriculture groups (1). Governments would have redesigned all policies, regulations, programs and services to be supportive of this health promoting, sustainable way of living.

The above represents a small contribution to a necessary collaborative visioning process that needs to be facilitated throughout the country as part of deciding what it is that we want to create (2). To do this effectively it will quickly become apparent that most of us will need much greater levels of literacy in a range of areas, and also full access to much information that is presently kept from us by governments and business. So early steps must include addressing these major barriers to change. To bring about sustainable change those concerned with such a transition must meet people where they are and support them in taking their own unique next meaningful steps. This is the opposite of the more common approach of preaching, shaming, manipulating and bribing to bring about change. In working with producers in transition to sustainable agriculture I have found it most effective to start by asking them what small initiatives they have already taken to farm more ecologically (to support regeneration of the soil, reduce dependence on inputs, etc.) - and to acknowledge and celebrate these - and then to ask them what next steps have they wondered about taking and what they need to take them, what the barriers are and how these could be removed. I have found that if this is done in a group, most of the agronomic problems can be solved by relying on the collective wisdom and resources of the group. With respect to the larger socio-cultural context it is important to be cognisant of the dominant trends and pressures, and of the things that are consequently being ignored or neglected. Some of these are listed in Figure 1.

Unless these world-views, values and political issues are addressed, all efforts to achieve sustainability will be undermined and unsupported. Consequently all programs for sustainable change must include plans and actions to achieve fundamental transformation in both our world-views and values and also the institutional structures and processes we design (and redesign) to support the transition.

Dominant Grand Narrative of 'Progress'	**Neglected/Blocked**
Production (regardless of cost)	Maintenance, caring
Growth, no limits	Sustainability, limits (resources, ecological....)
Competition	Collaboration, mutualism, synergy
Wealth	Sense of enough
Individualism	Community, mutualistic relationships
Consumerism (emphasising compensatory wants)	Conserver society (meeting basic needs)
Homogenisation, simplification	Maintenance of diversity
'Controlling' science ('understanding' science and arts as a disposable luxury)	'Understanding' science and arts
Powerful technologies (often centralised, imported, inaccessible, unrepairable)	Appropriate technologies (decentralised, locally accessible, repairable)
Market forces (manipulated demand, excessive advertising)	Values based decisions (participatory democracy)
Economic rationalism (monetary system of values)	Meeting the greatest 'good' (social justice....)
Trans-global corporate managerialism	Regional self-reliance and responsibility
Mobile, disposable work force (disconnected from place)	Sense of place, right to meaningful work
The myths that these are embedded in are inadequate for securing a 'good' future for most in present and future generations.	We need to search for new life-promoting myths that can accommodate these characteristics: some can be found within nature (and ecology)

Figure 1. Dominant pressures and areas of neglect in industrialised societies.

We also need to become more competent at working with the processes of change. One of the most useful tools in this area is Lewin's Force Field Analysis (3). Basically, Lewin argued that if we want to bring about a change, such as making Australian agriculture sustainable, we need to first identify the driving and restraining forces, and second figure out how to strengthen the former and weaken the latter. In doing this we need to consider these forces at every level within the system, from internal forces, such as creativity and fear, to external forces, such as global opportunities and restrictive international regulations. Taking all these factors into account, it is then necessary to establish personal, enterprise, local, regional, national and international goals, and to work alone and with others for their achievement.

I use a social ecology approach because it works (4). Unlike most maps for change it includes the personal (as well as social and environmental), and doesn't privilege economics. It emphasises working with chaos, complexity and the unknown, collaborating across difference, being competent in the area of design, particularly ecological design, and taking issues of power and gender into account. It sees change as a co-evolutionary process (5) and validates the taking of small meaningful steps and the public celebration of their completion to make them contagious! A first attempt at constructing a framework to support this approach is provided in Figure 2.

	PERSONAL core + adapted selves	**SOCIAL** **cultural diversity**	**ENVIRONMENTAL** **physical resources, biodiversity**
Sustainable Agriculture ?	**Impact - Degradation - Breakdown**		
	Need for meaning (fulfilling work), well-being, creativity, caring	Relationships Community Peace	Maintenance Sustainability
Sustainable Agriculture ?	***Agriculture is sustainable when it maintains the capital within the systems involved while achieving its other goals, including productivity and profit***		
	Personal meaning	Healthy society	Multi-species and functions Cycles Knowledge and skills *vs* inputs Appropriate technologies
to make it happen ?	Redesign of Self,	Social Systems,	and of Agroecosystems
	- through empowerment, awareness, values/world views, vision, development of new competencies, and mutual support		
	Acknowledgment of one's 'good' core, unique gifts and missions	Collaborative spirit Diverse personalities and competencies Local cultural uniqueness	Ecological services Coevolutionary processes Bio-regional ...uniqueness

bring about the change	***Acknowledge the past, vision the future and identify new "small meaningful acts" and celebrate them publicly to make contagious***		
	Interrupt distress behaviours Live fully and creatively in the present. Spontaneity, synchronicity	Reconciliation Supports, rewards, penalties Decentralise Participatory democracy	Regeneration Redesign of complex systems Time, space and roles Synergy, mutualism
HOW to	**Indicators of positive change**		
know if it made a difference	*Wellbeing* *Love* Creativity	Harmony Peace Celebration	Sustainability Biodiversity Ecological processes

Figure 2. A framework for making sustainable agriculture happen.

The process starts by asking 'what is the issue and why is it important?' Note that what we are concerned with here is a broader issue than just facilitating a transition from conventional to sustainable production and consumption. In fact, what we are involved with is the ongoing psychosocial evolution of our own species, which at this stage of our development is concerned primarily with moving from being preoccupied with control to focusing on supporting and helping strategies -- especially with respect to children, one another and ecological and community processes. Changing how we raise our children ('history is written in childhood') will, I believe, have much greater effects on achieving our goals than all other approaches combined (6).

In working with change, the primary resources we have to draw on are ourselves, especially our core self (called by some our true self, essence or the 'god' within). Our other or adapted selves are what we had to become to survive past traumas and difficulties. They are unfortunately what subsequently prevent us from making progress in the present by keeping us focused on accommodating, compensatory and substitution strategies. The other resources that we have to draw on are our cultural diversity and our creations, and nature and its rich biodiversity and life supporting processes. Most people are already aware of breakdown in each of these areas and they yearn for more meaning in their lives, particularly through more nurturing personal and community relationships. They recognise the need for ecological sustainability. So a central challenge is to show how sustainable agriculture can make a significant contribution in each of these areas. The model then asks 'what is sustainable agriculture?' Agriculture is sustainable when it achieves its personal (nourishment, wellbeing, meaning, creativity), social (community, social justice, harmony, peace) and environmental (productivity, biodiversity, habitat, aesthetics) goals, while both maintaining the capital, and being supportive of coevolution and development, in each of these areas. To make agriculture sustainable we particularly need to learn how to work with multi-species, multi-functions, multi-storey systems, cycles and appropriate technologies.

The next question is 'what's needed to make it happen?' and the answer is 'redesign' at every level. Here we must connect more clearly with our own agendas and missions and stop being enslaved by those who are resistant to such change. We must also work with what is available locally, both socially and ecologically. The next question is 'how can we actually bring about the changes?' This may involve some personal recovery and development work to reclaim and expand our vision and power, and some reconciliation work to enable different groups to work together effectively. Eventually this will also require most of us to be much more politically competent and active. Most ecosystems will require regeneration work and fundamental redesign to enable us to manage much more complex systems and be much more precise in where and when we do things. Much of this redesign should be aimed at reaping the benefits of nature's natural synergy and mutualism. Politically, we need to work at every level to design more appropriate and effective supports, rewards (incentives used only during the transition period to prevent the development of dependence) and penalties (Fig. 3).'

Finally, the model asks 'how will we know if we are making progress?' To answer this we will need an extensive array of reliable personal, social and environmental indicators of both 'positive' and 'negative' change.

Although these suggestions are necessarily general, earlier papers have provided numerous examples and more detailed arguments (7). However, the details need to be defined by all who take on the task, given their particular backgrounds, competencies and local conditions. Participatory Action Research, Collaborative Inquiry and Rapid Rural Appraisal approaches to change are particularly suited to this inclusive kind of project (8). It is certainly achievable. We just have to decide to prioritise it, find ways to work together, and to DO IT!

Let me close as I started. What an exciting prospect: of everyone who reads this using it as an opportunity to reflect on and celebrate what you have already done and are currently doing to bring about this transition; to share this article and your visions, competencies and resources and struggles with friends and neighbours; and to ask for help and to work together to make Australian agriculture sustainable. What an exciting prospect -- in no time at all the whole country will be engaged in achieving this wise goal. ✪

Supports

- Education, demonstration models.
- Extension and other services.
- Research and development.
- Legislation, regulation.
- Policy, planning, public participation.

Rewards

(available only during the transition period)

- Tax incentives.
- Subsidies.
- Low interest loans.
- Special services for change.

Penalties

(for those who act irresponsibly)

- Monitoring programs.
- Legislation.
- Enforcement.

Figure 3. Forms of Political Action

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SPEAKER PROFILE.

Professor Stuart B. Hill was appointed Foundation Chair of Social Ecology at the University of Western Sydney (Hawkesbury Campus) in 1996. Prior to that he had been at McGill University, in Montreal, Canada, where he had coordinated McGill's zoology major, and established, in 1974, Ecological Agriculture Projects (http://www.eap.mcgill.ca), Canada's leading resource centre for sustainable agriculture. He has published over 280 papers and reports, and in Canada was a member of over 30 regional, national and international boards and committees, and he is currently on the editorial board of four refereed journals. He has successfully completed projects in the West Indies, French West Africa, Indonesia, The Philippines, and the Seychelles, as well as in Canada and Australia.

Dr. Hill is committed to working for change that improves ecological sustainability, and community and personal wellbeing, and our psychosocial coevolution. He is critical of the still dominant tinkering (shallow) responses to problems, as well as their endless measurement, and is a tireless campaigner for the pro-active, fundamental (deep) redesign of our lifestyles, our institutional structures and processes, our managed ecosystems and our technologies. His background in ecology, soil biology, entomology, agriculture, psychotherapy, education, policy development and international development, and his experience of working with change, have enabled him to be an effective facilitator in complex situations that demand both collaboration across difference and a long-term evolutionary approach to situation improvement. As this is a focus of social ecology, he is currently in an euphoric state as a member of a dynamic learning and action community (of over 300 staff and students) with overlapping values and mutually supportive projects. Enquiries about Hawkesbury's Social Ecology programs should be directed to Kathy Adam, Faculty of Social Inquiry, UWS-H, Locked Bag No. 1, Richmond, NSW. 2753. Phone: 02 4570 1288. E-mail: k.adam@uws.edu.au.

HISTORY AND GROWTH OF SUSTAINABLE AGRICULTURE IN THE UNITED STATES AND RESEARCH PRIORITIES

— JIM HORNE —

PRESIDENT
KERR CENTER FOR SUSTAINABLE AGRICULTURE
POTEAU, OK

The history and growth of sustainable agriculture in the United States has been interesting as a social movement in agriculture. Its progress has often been stalled by conventional agriculturists, academia, and agribusiness. Acceptance of sustainable agriculture by mainstream farmers in the early years has been slow; however, the enthusiasm, passion, and achievements of advocates for sustainable agriculture have been quite remarkable. The tide toward sustainable agriculture is now changing as conventional agriculture continues to operate in a crisis mode because of low commodity prices and high input costs.

Early pioneers of sustainable agriculture included folks like Wendell Berry, Wes Jackson, Robert Rodale, and other like-minded people. In the beginning, there was considerable debate over the terminology. Rodale liked the concept of 'regenerative' agriculture and Jackson held fast to the term 'sustainable' agriculture. Both had strong arguments for their positions on what this movement should be called. However, conceptually they both were advocating for essentially a new paradigm shift in agriculture away from the industrialization of agriculture.

In 1985, USDA formally recognized sustainable agriculture in its Farm Bill. It was labeled low input sustainable agriculture (LISA). In 1988, $3.9 million was appropriated to establish the program. The term 'LISA' turned out to be a mistake, in terms of its name. It automatically got the attention of chemical and ag input suppliers. Almost immediately these companies began publishing anti-LISA material. It was rather a unique overreaction to see the industry up in arms over a small struggling $3.9 million program in the corner office of USDA.

In the 1990 farm bill the name was changed to the Sustainable Agricultural Research and Education Program or the acronym 'SARE'. Under the farm bill, the term 'sustainable agriculture' was defined to mean an integrated system of plant and animal production practices having a site specific application that will over the long term:

— satisfy human food and fiber needs;

— enhance environmental quality and the natural resource base upon which the agricultural economy depends;

— make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls;

— sustain the economic viability of farm operations; and

— enhance the quality of life for farmers and society as a whole.

In January, 1988 the Secretary of Agriculture released the following departmental policy on sustainable agriculture. "The department encourages research and education programs and activities that provide farmers with a wide choice of cost effective farming systems including systems that minimize or optimize the use of purchased inputs and minimize environmental hazards. The department also encourages efforts to expand the use of such systems."

The establishment of the SARE program was an important step in sustainable agriculture. The mission of the program was to promote research that expands knowledge about agricultural practices that are:

- Economically viable
- Environmentally sound
- Socially acceptable

SARE funds were established to fund four different kinds of projects:

- Research and education
- Producer grants
- Graduate student grants
- Professional development

In 1988, with the funding of 'LISA' which later became the 'SARE' program, the focus in research and education projects was primarily on whole systems research, inter-disciplinary work, multiple institutional cooperation, and multiple state proposals that depended on heavy participation by farmers.

There were three chapters in the legislation that were authorized. There were: Chapter 1: Research and Education Competitive Grants; Chapter 2: Integrated Resource Management; and Chapter 3: Professional Development Program. While Chapter 1 activities were primarily research and education, Chapter 2 has never been funded. Chapter 3 was designed as a professional development program for ag professionals. Under this chapter there were to be established regional training centers that would offer competitive grants in technology transfer. State coordinators would be appointed and specialists in sustainable agriculture would work in this capacity to develop state training programs for extension, NRCS, and other professionals.

In 1994, SARE started making grants to producers. This was partly to get farmers more actively involved in research and to also get researchers more active in coming to farms to conduct research. These grants were often awarded for a maximum of $10,000 for up to three years for farmers to undertake on-farm demonstration and research projects.

SARE is rather unique in how it is organized. The SARE program operates with four regional councils administering the program. These administrative councils are composed of a wide spectrum of stakeholders in agriculture. These councils determine the kinds of research and professional development training that is to occur within each region. This has proven to be a very successful model for allocating scarce dollars to support sustainable agriculture and has enabled many organizations to work together that might not have had the opportunity before.

For example, in each region the SARE program is administered by an administrative council which also has a technical advisory committee that serves as a project review committee for proposals. The administrative councils vary in size but usually include 20-24 members. This includes 1862 and 1890 land grant representatives, researchers, government agency representatives, extension agents, farmers, non-profit organizations, and ag-business professionals. It is made up of peers of the people submitting proposals and the constituency that will benefit from the research. The administrative council and technical advisory committees in each region help insure that research projects are applicable to farming problems in the region.

One of the big reasons for the success of SARE is that it is participatory. Farmers are involved in all facets of SARE as advisors, evaluators, and cooperators. They help design and conduct the on-farm research. SARE is inclusive. It is inclusive from the point of decision-making about what research projects to fund to that of how to broaden the scope of the entire SARE grant program.

SARE also addresses the needs of limited resource farmers and farmers of small holdings who are often overlooked in traditional grant programs. SARE is also unique in that it encourages a multiple-disciplinary team approach to solving problems. It is the philosophy of SARE that agricultural sustainability requires true multi-interdisciplinary research. SARE uses a systems research model for its research and education products. SARE projects incorporate very diverse scientific disciplines, different types of institutions and organizations, and tries to integrate the needs of farm households, farm workers, managers, firms, consumers, and communities in the projects that it supports.

The goals of SARE are to fund a diverse array of projects which provide critical information and insight on sustainability to multiple stakeholders who have a direct investment in project outcomes. It is hoped that through this program that institutional and collaborative capacity will be increased in each region so that problem solving becomes more flexible, effective, participatory, inclusive and applicable.

Conclusions

While SARE has done a great deal to enhance the viability of the sustainable agriculture movement throughout the United States, it is still a small program within USDA. While it has made significant improvement in making people more aware of sustainable agriculture, much more needs to be done. There is always a continual fight to keep funding for SARE. Were it not for a few friends in the legislature, SARE probably would not still exist today. However, in my own mind, I am quite sure that the passion of the people in the sustainable agriculture movement would find a way to survive, whether there is USDA funding for this program or not. Sustainable agriculture, at some point in time, will become the conventional agriculture of the future. There will be a lot of bumps in the road before we get there, and it will require patience, persistence, good planning, and being able to work with diverse stakeholders and consumers to make this happen.

Research

There are several research needs and priorities that need to come to pass to really make sustainable agriculture the science that it ought to be. I would summarize some of the research needs and challenges ahead of us as really to begin thinking about holistic systems and how to make scientific measurements of some of the activities that happen when we start examining whole systems. Indeed, the science of measuring how mechanisms are at work in nature is a very difficult process. But somehow if we are to be a holistic agriculture we have to think about how to make these measurements.

Research Needs and Challenges

(1) Development of research capacity to measure and explain synergy coming from interactions in holistic agro-eco systems.

(2) Development of total cost accounting systems that attempt to measure external costs of the production process.

(3) Incorporation of systems thinking in research projects.

(4) Identification of sustainable best management practices that can in the short term be profitable and yet remain in the long term sustainable.

(5) The involvement of farmers in the planning, testing, and evaluation phases of research to ensure that the technologies or the practices that are developed are farm ready.

While these are very general research challenges that need to be addressed, I would like to present the following areas as priorities that must be worked on in order to achieve a sustainable agriculture. I have devised a set of ten criteria that I think is essential for a sustainable agriculture. Research projects need to incorporate as many of these elements as possible.

(1) Building healthy soil and conserving it.

(2) Keeping water clean and conserving water.

(3) Management of livestock waste and other products so they do not pollute.

(4) Selecting plants and animals that are adapted to the environment.

(5) Restoring farm profitability.

(6) Managing pests ecologically and with minimal environmental impact.

(7) Protecting habitat and encouraging biodiversity.

(8) Taking maximum advantage of solar energy and place less reliance on petroleum-based chemicals and fuels.

(9) Ensuring that we are building sustainable farm communities that are resilient.

(10) We impart social equity in our projects to achieve, not just equity today, but intergenerational equity for the future. ✪

SPEAKER PROFILE

Dr. James (Jim) Horne earned a Bachelor of Science degree in Agricultural Education at Oklahoma State University in 1969. He later obtained Master of Science and PhD degrees in Agricultural Economics. In 1972, he joined the Kerr Foundation as a consulting agricultural economist.

Dr. Horne serves now as President and Chief Executive Officer of the Kerr Center for Sustainable Agriculture. He has guided the organization in developing a program of sustainable agriculture research and demonstrations. This program is based on concept that ensure a viable agriculture without degradation of natural resources. These concepts, demonstrations, and applied research are in use at the Kerr Center's 4,000 acre stewardship ranch near Poteau, Oklahoma. The other major programs of the Center include a farmer grant program, and a public policy analysis program.

Dr. Horne has served as chairman of the Southern Region Council for the U. S. Department of Agriculture's Sustainable Agriculture Research and Education (SARE) Program; as a member of the Scoping Task Force on Sustainable Agriculture for the President's Council on Sustainable Development; and as chairman of the U.S.D.A.'s National Sustainable Agriculture Advisory Council.

Saskatchewan
Agriculture
and Food

ORGANIC INDUSTRY NEEDS ASSESSMENT

RESULTS OF WORKSHOPS AND QUESTIONNAIRES

— DESIREE JANS —

SASKATCHEWAN AGRICULTURE AND FOOD
MARCH 2001

Between December 2000 and March 2001, the Saskatchewan Agriculture and Food (SAF) Organic Opportunity Team organized several organic needs assessment workshops and mailed questionnaires to almost 600 organic producers.

Response was very good. About 215 people attended workshops and more than 200 completed questionnaires were received.

Participants were asked to identify barriers to industry growth and specific needs in terms of marketing, production research and development, extension, and risk management (i.e. crop insurance).

Results of the workshops and questionnaires were combined to identify the top priorities in each area. The comments are detailed below. Tables are also included that summarize quantitative results from the questionnaires. Saskatchewan Agriculture and Food will use this input to help develop its plans to support the organic industry in Saskatchewan.

Industry Barriers

The top three industry barriers were identified as:

1. lack of an internationally recognized certification system;
2. widespread use of Genetically Modified Organisms (GMOs) and potential contamination; and
3. lack of marketing information.

Development of an internationally recognized certification system is underway. The needs assessment did not specifically address this process. However, from the questionnaires, it appears that the majority (59%) of respondents thought that the federal government should be involved in developing and implementing the certification process. A slim majority (52%) thought that the provincial government should not be involved. A majority thought that compliance with a national organic standard should be mandatory (67%) and regulated by federal legislation (68%).

The GMO issue arose in every workshop and on most questionnaires. Several policy recommendations were made to mitigate the GMO issue including:

1. a moratorium on production and marketing of GMOs;
2. more thorough evaluation of the impact of GMOs on health and the environment;
3. more stringent regulations/enforcement to avoid GMO contamination from field level all the way to the consumer; and
4. better identity preservation systems to maintain organic credibility.

To better understand the impact of GMOs on the organic industry, SAF has committed to meet with a group of organic producers in early April 2001 to discuss the issue.

Lack of marketing information was also identified as a major industry barrier. This is addressed in detail in the marketing section below.

Marketing

The top priorities related to marketing were identified as:

1. need for an internationally recognized certification system;
2. market insight;
3. consumer education; and
4. dedicated organic processing facilities.

The need for an internationally recognized certification system was unequivocally the top priority for marketing and was also identified as one of the top barriers to organic industry development. It will not be discussed further here.

Market insight requires the acquisition of information about demand and trends, market prices and volumes, cost of production, and buyer/seller listings. Information could be distributed through a newsletter or posted on a website, which would also enhance the potential for e-commerce. These activities could be coordinated by the organic industry or by SAF.

Consumer education is required. This includes education about the meaning of the term "certified organic," about the health benefits of organic foods and about the environmental benefits of organic production systems. It was suggested that products be labeled with a standard national symbol to promote product recognition.

Education campaigns could be led by the organic industry and could be local to international in scope. The campaigns would employ brochures, advertising, and tradeshows. It was also suggested that a consumer-accessible directory of locally available organic products be develcped and that market recognition of "Saskatchewan-grown" products be improved.

There is a need for dedicated organic processing facilities, both for crops and livestock. Specifically, these should be regional processing facilities accessible to local producers. Feasibility studies could be undertaken prior to supporting these types of ventures. SAF could offer funding incentives or processors could establish New Generation Co-ops.

Other marketing needs included fostering marketing groups (producer co-ops), more storage facilities for organic produce and meats, and stricter regulations/tougher penalties for misrepresentation and/or contamination of organic products.

Questionnaire results for marketing

(% of respondents that listed each item as #1, #2, and #3 priority and the weighted sum)

	#1	#2	#3	Weighted Sum
Internationally recognized certification system	35.4	17.8	13.4	155.2
Info on market demand/trends for organic products	16.6	14.4	11.6	90.2
Info on organic buyers/traders	9.1	16.7	14	74.7
Consumer education	10.3	12.6	13.4	69.5
Buyer/seller matchmaking service	10.9	9.2	9.9	61
Dedicated organic processing facilities	4	9.2	16.9	47.3
Info on products and quantities that SK can supply	4.6	9.8	9.3	42.7
Identity preservation	2.3	5.2	6.4	23.7
Information on competition	1.7	1.1	0.6	7.9

Weighted sum = (%first priority x 3) + (%second priority x 2) + (%third priority x 1).

Production Research and Development

The top three priorities identified for production research and development were:

1. managing soil fertility and quality;
2. studying crop rotations in relation to soil, weeds, insects, and diseases; and
3. managing weeds.

Organic agriculture takes an ecological approach, which makes it difficult to isolate and test specific production factors. Organic production research must take a systems approach.

Several people indicated that the most valuable information would come from on-farm research. Ideas included documenting production practices of experienced organic producers and/or setting up a network of regional demonstration farms. Producer involvement in directing research was also important, perhaps through a producer committee with representation from different parts of the province. Several people wanted organic systems' research to be part of the Spoke Site Program. Specific mention was made of the alternative cropping studies at Agriculture and Agri-Food Canada's Scott Research Farm.

A specific concern regarding soil fertility was the decline in soil phosphorus levels in some organic systems. Other concerns included maintaining nitrogen fertility and a need for more accurate indicators of soil quality including status of micronutrients and microbial activity.

Crop rotation research should focus on rotational impacts on soil and weeds and, to a lesser extent, on insects and diseases. Some specific comments included monitoring soil fertility and quality in response to rotations (preferably including animal manures and/or livestock grazing) and information on crop-specific fertility requirements. Also mentioned was the need to study pulses in rotation and the need for organically-acceptable inoculants.

There was also interest in the interaction between soil fertility, rotations, crop residues and weed populations. Problem weeds included Canada thistle, wild mustard, quack grass and wild oats. The use of biological weed control (ie. bacteria to control weeds) was not widely mentioned.

Another area of interest was breeding and testing of crop varieties in organic systems including bio-regionally based tests of "heritage" varieties.

Research into the impact of agriculture on the environment and health was mentioned by several workshop participants. Concerns included:

1. GMOs;
2. food safety (bioload and pesticides);
3. pesticide residues (in food products, water and in relation to human health);

4. the sustainability of organic systems (environmentally and economically); and
5. need for renewable energy for heating and running equipment.

Several other areas were mentioned, but were not identified as top priorities. These included the development of specialized and small scale equipment and research into value-added processing.

Some general comments were as follows: need better coordination between research facilities, need better communication between organic industry and research agencies, research should be done by independent bodies, need better accessibility to product information (directory of seed growers' and acceptable inputs, standards for testing products as "organically-acceptable").

Questionnaire results for production research and development

(% of respondents that listed each item as #1, #2, and #3 priority and the weighted sum)

	#1	#2	#3	Weighted Sum[1]
Managing soil fertility and soil quality	34.8	18.2	12.2	153
Managing weeds (biological/cultural)	13.3	19.9	8.9	88.6
Crop rotations (soil, weed, insect, disease responses)	8.3	17.1	15	74.1
Understanding probability of pollen transfer from GMO crops	14.9	7.7	8.3	68.4
Quality and nutrition of organic foods	7.2	7.7	7.2	44.2
Breeding/testing varieties for suitability in organic systems	4.4	5	10	33.2
Producer involvement in directing research	3.3	5	6.1	26
Managing crop insect pests	1.7	3.3	5	16.7
Yield improvement	1.1	3.9	4.4	15.5
On farm research and/or regional demonstration farms		3.3	7.2	13.8
Managing crop diseases	0	2.8	5	10.6
Specialized equipment for organic production systems	1.1	0.6	2.8	7.3
Animal health and nutrition	0.6	0.6	3.9	6.9
Economic feasibility of animal production	1.1	0.6	1.7	6.2

Weighted sum = (%first priority x 3) + (%second priority x 2) + (%third priority x 1).

Extension

The top three priorities associated with extension and technology transfer were:

1. extension courses on organic farming;
2. organic publications and conferences; and
3. website or other directory of organic information

A number of people at the needs assessment workshops had taken introductory Agricultural Institute of Management of Saskatchewan (AIMS) funded extension courses on organic farming and had found them useful.

Many wanted more extension courses on advanced topics such as specific agronomic practices, marketing, or business planning through the transition phase. These courses should include input from experienced, successful organic farmers. Courses could be arranged through SAF, the University of Saskatchewan and/or community colleges.

Organic publications and conferences were also a priority. Publication ideas ranged from crop and livestock agronomy to marketing issues. Publications should be prepared by credible, independent organizations. Annual conferences and tradeshows should continue and should be located throughout the province. It was recommended that publications and conferences be coordinated by the organic industry and/or SAF.

Several people said they had trouble finding available organic information. A central website, directory, or agency was suggested to collect publications and resource links. This effort could be coordinated by the organic industry and/or the university. If a website is established, SAF should be linked to it.

The need for SAF regional specialists who are trained in organic production or who have experience in organic farming was mentioned. It was also suggested that SAF hire at least one full-time organic specialist who would provide technical advice and promote the organic industry.

Other needs were identified, but were not listed as priorities. These included:

1. better support for organic agriculture at the University of Saskatchewan through organic programs and courses,
2. partnerships between SAF, the U of S and the organic industry for planning and delivering extension; and
3. signage for organic fields, which would help to increase awareness and also be visible to aerial operators.

Questionnaire results for extension

(% of respondents that listed each item as #1, #2, and #3 priority and the weighted sum)

	#1	#2	#3	Weighted Sum
Production manuals and fact sheets on organic farming practices	19.2	11.8	18.8	100
Courses on conversion to organic (agronomic/admin/marketing)	18.6	12.4	6.9	87.5
Co-operative approach among producer groups/CBs/SAF	18	11.2	10.6	87
Courses on advanced aspects of organic production	8.7	21.3	11.3	80
Certificate in Agriculture program at the U of S	9.9	4.7	10	49.1
Information on economics of organic production	4.7	11.8	8.8	46.5
Provision of SAF regional organic specialists	7.6	5.3	8.1	41.5
Conferences	5.2	8.3	8.1	40.3
Field tours of organic production	3.5	6.5	9.4	32.9
Extension personnel to facilitate producer meetings	1.7	3.6	6.9	19.2

Weighted sum = (%first priority x 3) + (%second priority x 2) + (%third priority x 1).

Risk Management (Crop Insurance)

Overall, insurance did not seem to be a major concern for organic producers. Some commented that insurance for the transition period would be useful while others said that insurance should be better related to the real market value of organic crops. Several were interested in more information regarding available insurance for organic production.

Questionnaire results for risk management

(% of respondents that listed each item as #1, #2, and #3 priority and the weighted sum)

	#1	#2	#3	Weighted Sum
Info on risk management	35.6	10.6	16.3	144.3
Yield loss insurance	19	23.6	13.6	117.8
Marketing insurance	11.7	22.9	24.5	105.4
Insurance against losing certification	14.1	16.6	10.9	86.4
Quality loss insurance	6.7	17.8	23.1	78.8
Transition insurance	4.9	5.7	8.8	34.9

Weighted sum = (%first priority x 3) + (%second priority x 2) + (%third priority x 1).

Acknowledgements

The Saskatchewan Agriculture and Food Organic Opportunity Team would like to thank all who shared concerns and ideas at workshops and who took the time to complete the questionnaire.

For more information or to submit additional comments, please phone Blaine Recksiedler, SAF's Provincial Specialist for organic crops, 787-4664, or e-mail brecksiedler@agr.gov.sk.ca

For information about research funding for organic production projects, phone Desirée Jans, Program Manager, Agriculture Research Branch, Saskatoon, 229-0035, or e-mail djans@agr.gov.sk.ca

This report will be posted on the SAF website at www.agr.gov.sk.ca

Organic Production Survey

The Saskatchewan Organic Directorate (SOD) recently completed a survey of organic production in Saskatchewan. The survey was funded by SAF. Data include total certified acres, types of crops and livestock, and numbers of certified producers. An abridged version of the survey results will be printed in SOD's spring newsletter.

Copies of the report are available from SOD (Debbie Miller: Tel. (306) 476-2089; Fax. (306) 476-2146; e-mail debbie.miller@saskorganic.com) or SAF (ask for ADF Project # 20000202: Production Statistics for Organic Agriculture in Saskatchewan for 2000).

This report was prepared by:

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SPEAKER PROFILE

***Desiree Jans** did her undergraduate studies in Plant Sciences at UBC and was a Soil Conservation Agrologist with Alberta Agriculture for two years. Ms. Jans did a PhD at the U of A in Soil Biology and Biochemistry studying C and N cycling following legume green manuring. This helped her to gain an appreciation for the ecology of agro-ecosystems.*

In 1996, she joined Agrium Biologicals as a Research Scientist leading a team in the development of novel microbial formulations, specifically, long-lived seed applied rhizobial formulations.

Ms. Jans is now a Program Manager with Saskatchewan Agriculture and Food looking after research contracts for ADF and AFIF-funded projects in the areas of soils, horticulture and some crops. She is also the Agriculture Research Branch representative on the SAF Organic Opportunity Area Team and has a personal interest in the practice and philosophy of organic farming. She is also involved with the Native Plant Society of Saskatchewan and has been its part-time coordinator.

SOIL FERTILITY RESEARCH FOR LOW-INPUT AND ORGANIC FARMING SYSTEMS: U.S. PROJECTS, PERSPECTIVE

— LYNNE CARPENTER-BOGGS —

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The U.S. research community has been slow to realize and react to the research needs of low-input and organic farms. Technology-driven "green revolution" agriculture has been seen for over 50 years as the singular goal of U.S. agriculture. Alongside this vision of advancement, low-input and organic agriculture have been viewed as "backward" and therefore ignorant of, and not needing, science of its own. This lack of attention is evident in the fact that 39% of U.S. Land Grant Institutions (university centers developed specifically to serve the agricultural industry and farm community) have no informational pamphlets developed for organic farms. Another 39% have only 1-4 pamphlets for organic methods. The California-based organization Organic Farming Research Foundation (OFRF), recently surveyed organic producers for their ideas on research needs and barriers to organic production. One of the most common-ly cited barriers to conversion to organic farming was the lack of knowledge and support from extension agents, universities, and the U.S. Department of Agriculture (USDA).

A few years ago, OFRF also surveyed all current descriptions of funded USDA research for its mention of and relevance to organic farming. The resulting document, called "Searching for the 'O' Word," cited only a handful of relevant projects, and helped convince the USDA to take organic producers and their needs seriously.

Since "Searching for the 'O' Word," more researchers and administrators have looked for new slants on ongoing research, and ways that these current projects could relate to organic agriculture. In some cases, this has led to substantive changes in the goals or methods of research. In other cases, "organic" or "low-input" has simply been added to the titles of some documents. Some of the ongoing conventional agriculture research that recently has been cited as currently or potentially also serving organic or low-input agriculture include the following:

- site-specific farming: fertilizers and amendments applied at levels that maximize productivity and minimize waste on each soil type and/or landscape position
- carbon or organic matter storage: to enhance soil physical, chemical, and biological characteristics and/or provide a carbon sink to help meet Kyoto Protocol guidelines
- regionally and locally appropriate rotations
- soil quality: early indicators of beneficial or detrimental change and the effects of various management options
- optimizing input rates to control input costs and reduce non-point source pollution (agricultural runoff and leaching)
- use of biological inoculants, e.g. rhizobia and mycorrhizae: microbial symbionts of crop plants that allow nitrogen fixation and better phosphorus uptake. Inoculation is usually beneficial when a new crop is grown or significant farm system changes have occurred.

Research specifically geared toward the needs of low-input and organic producers that currently enjoys some level of public support include the following:

- biological or management control of weeds, pests, and pathogens
- nutrient balancing or cation ratio methods of fertility analysis, such as the Albrecht system
- alternative sources of nitrogen, particularly on-farm or rotational options

Issues of nitrogen source and application truly do span from conventional to organic farms. Nitrogen (N) pollution of groundwater threatens human and animal health. Over 10-ppm nitrate in drinking water can cause methemoglobinemia or “blue baby syndrome.” Many agricultural areas have undrinkable ground water because nitrate levels are too high. Nitrate in surface waters can cause eutrophication or hypoxia, resulting in the death of fish and many other aquatic animals. Any farm can be guilty of N pollution. In the U.S. some organic farms, particularly areas where organic production has traditionally been concentrated such as Amish settlements, have been significant sources of N pollution of ground and surface waters. This has also been a problem where short-term planning leads to “organic farming by the substitution method.” That is, simply substituting organic forms of nutrients and pesticides for manufactured forms that are not allowed for organic certification. Raw manure is one of the most dangerous substitutions for mineral N fertilizer because manure N is readily available and can be quickly leached out into soil or rainwater. Therefore most manure, compost, and biosolids application research is considered to have relevance for both conventional and organic farms.

As part of the USDA' s response to the needs of low-input and organic producers, the focus of several federal research farms has shifted. The USDA-Agricultural Research Service (ARS) lab at Beltsville, Maryland, the closest lab to Washington DC, has initiated a variety of organic and low-input management plots, primarily working with legume rotations and dairy waste inputs to maintain organic certification and high yields. Our lab in Beckley, West Virginia works with the sustainable culture of native plants and agroforestry systems. Biocontrol of pathogens and weeds is researched primarily at Salinas, California and Pullman, Washington. A Yakima, Washington lab is also initiating plots primarily for organic orchard management.

The U.S. agricultural research community's increasing interest in the real needs of farmers can be seen in the research planning process of the USDA-ARS. A purposely diverse group of producers and industry representatives is called to help develop each of the USDA-ARS' new programs. The topics of soil quality, soil biology, and organic farming methods have been prominent issues. These topics have increased credibility and importance relative to many more traditional topics because of the input of diverse farmers. The magnitude of support for these research issues from farmers has been a great but welcome surprise to many of our researchers and administrators.

Beyond the short-term management of alternative N sources and defeating of insects and pathogens, sustainable low-input and organic management depends upon building soil quality, or inherent soil fertility. Very few research institutions have the long-term low-input or organically managed plots needed to sufficiently study this issue, so we are often in the position of lagging behind experienced organic farmers. This creates a new and rewarding relationship: listening to producers, learning from their experience, and building on that knowledge to develop principles. What we now call "soil quality" is based on an old idea, "feed the soil,"

Lynne Carpenter-Boggs
(photo by Darryl Amey)

that needs and deserves further development. It is a slow and difficult process for researchers to realize that organic farming is not a step backward, but a step forward in a new direction. ✪

SPEAKER PROFILE

***Lynne Carpenter-Boggs** is a soil microbiologist at the USDA-ARS in Morris, MN. Her research concerns changes in soil microbial communities, processes, and soil organic material in response to agricultural disturbances and amendments; decomposition and management of farm wastes; characterizing microbial and soil quality parameters in high quality soils; sustainable agricultural management and alternative microbial soil amendments. In 1991 she earned her BS Magna Cum Laude in Biophysical environmental Studies, Northland College, Ashland, WI.; in 1994 she finished her MS in Soil Science (Soil Microbiology and Biochemistry), at Iowa State University, Ames, IA.; in 1997 she earned her PhD in Soil Science at Washington State University, Pullman, WA.*

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ENHANCING SOIL FERTILITY IN ORGANIC AND LOW-INPUT AGRICULTURE

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Soil fertility in organic and low-input agricultural systems can be based partially on outside inputs such as rock powder and other farms' livestock wastes, but also depends on inherent soil fertility. Soil quality and inherent soil fertility are based on internal nutrient cycling and storage in the soil. These interactions are based to a large degree on microbial activities. Soil microorganisms decompose organic residues, cycle nutrients, turn atmospheric nitrogen into soil nitrogen through nitrogen "fixation", improve soil structure with strands and glue-like byproducts, and help to control pathogens. Organic and low-input producers must be more aware of the activities and needs of soil microorganisms.

Soil microbes, like all organisms, need a stable food supply and favorable environment. Any organic material can be food for microbes. Diverse organic materials will support a diverse microbial community. Microbes can decay any organic material to some degree, but if you want to avoid immobilizing nitrogen in the microbe bodies, organic materials applied in the spring should have a carbon-to-nitrogen ratio (C:N) of less than 30:1. Besides physical and nutritional requirements, it is important to remember that microorganisms "need to be needed." That is, if the farm system depends on and supports microbial activities, more microbial biomass and activities will develop. If the farm system depends on manufactured inputs instead of biological inputs, beneficial microbial biomass and activities will decline.

A side effect of high-input agriculture is often increased pest and pathogen problems. If thesoil "bugs" aren't working FOR you they are more likely to work AGAINST you. Soil biota includes hundreds of pathogens, which are more likely to dominate the soil community if the beneficial microbes are suppressed. Beneficial microbes thrive when the soil system depends on them for nitrogen fixation, decomposition, and nutrient cycling. When the beneficials dominate the community, they suppress pathogens by competition.

There is a saying among microbiologists that "everything is everywhere; the environment selects." This is not entirely true, but the biomass, community structure, level and types of activities of soil microorganisms are indeed highly dependent on their environment. For this reason, microbial inoculants are often ineffective unless they are used in an environment that is ready for, and in need of, the organisms being introduced. To maximize beneficial microbial activities, follow the proverb of organic farmers, "Feed the soil." An appropriate environment will allow more effective inoculation and can reduce the need for future re-inoculations by sustaining the beneficial community.

Habitat and food for diverse beneficial microorganisms can be built in the soil by maintaining a high soil organic matter (SOM) content. The population of soil microbes is very high around plant roots, so heavily rooted crops also stimulate more microbes. Perennial crops not only tend to produce a good root mass, but they provide food and ground cover over the soil's vulnerable periods. In addition, some agrichemicals have negative impact on soil "bugs." Anhydrous ammonia, nematocides, and ammonia-rich and sulfur-rich fertilizers can directly harm soil life or indirectly hamper their growth by decreasing soil pH (acidification).

Again, the primary focus should be on organic matter. Not only does organic matter provide a good microbial habitat, but it also is a great benefit to chemical and physical soil characteristics. Moisture, pH, nutrient supply, and the biological community are all more stable, or buffered, with more SOM. Organic matter helps to increase water infiltration and moisture storage; supplies N, phosphorous (P), and micronutrients; and provides storage capacity (cation exchange capacity or CEC) for ionic nutrients.

Soil characteristics are influenced by climate, type and age of parent materials (original rock from which soil is formed), topography (landscape position), and living organisms including vegetation. Most of these factors cannot be controlled by humans. The climate and parent material may be an insurmountable limit to a soil's potential fertility and SOM. Within these ecosystem boundaries, however, we can enhance soil through vegetation as well as organic and mineral inputs.

There are many sources of SOM and many ways to build more in the farm soil. Manure, compost, and biosolids are an obvious source of both N and OM for soil building. Compost is likely the best choice for building SOM, followed by biosolids and raw manure. Manure is relatively unstable and can quickly decay and release its N. Manure is therefore an excellent short-term fertilizer that also has some long-term soil benefit. More stabilized material, particularly compost, will serve as a long-term fertilizer and soil amendment. Humic acids are formed in the composting process, which will be stable SOM in the soil.

Crops and rotations can also build SOM. Soil organic matter is primarily carbon, with a C:N of around 11:1. Nitrogen must be available annually for crop growth, but often modern farmers do not consider that the soil also needs carbon for its long-term health. Crop residues can slowly become SOM, and the more that is put in, the more that is likely to stay. SOM can be built by frequent large additions of residue and root matter. Therefore, continuous cropping with highly productive crops, with abundant growth both above and below ground, can build or at least help to maintain SOM. Bare fallow periods should be avoided.

Purchased inputs of peat and humic acids can also help to build SOM, although it can be an expensive route. Peat and other lignified materials have a very low nutritive value. They do not directly enhance the soil fertility and are poor food for microbes. They do still have excellent physical characteristics, which can increase tilth and water retention to benefit productivity and biotic activity. Humic acids are complex combinations of partial decay and microbial products. Humic acids are also not high in nutrients, but may serve as a catalyst for the building of SOM through polymerization.

Another source of SOM is the living biomass of the soil. In a mollic topsoil with approximately 5% SOM, there will be in the order of 7-8 tons of living biomass per hectare. This living biomass feeds on, becomes, and is part of the SOM. Nearly all of the organic nitrogen in the soil will cycle through the soil biomass. It is a temporary storage unit of many of the most unstable nutrients. The constant feeding of soil organisms keep the soil from losing large amounts of N and P, for instance. Every soil, even intensively chemically managed soil, will have a living biomass. However, in many cases the population is unstable, rising and falling seasonally with the application of fertilizers, moisture, and crop material. When conditions become unfavorable, the soil biota can die or go dormant. This stops their role in nutrient cycling, and those materials are more likely to be lost, especially if the organisms actually die. The key is to support a stable biomass through maintaining a consistently high SOM soil.

Fertilization can be both beneficial and detrimental to SOM. Fertilization (in whatever form) is done primarily to increase crop growth. More crop growth means potentially more crop residue, which is "bug" food and potential SOM. However, fertilizers (especially mineral forms) also make it too easy for the crop to obtain its nutrients. With fertilizers, crop root growth is often proportionately less and symbiotic relationships with soil microbes decline because they are not needed. Also, a sudden influx of fertilizer nutrients can either stimulate or impede microbial activity in the short-term. Either situation can lead to a long-term loss of soil nutrients.

The first key to building SOM is to *maintain* the existing and added SOM. Any addition of organic material can be quickly lost, leaving no net gain. An increase in permanent SOM means that part of the organic inputs must not be fully decayed. When material is decomposed by microbes, a great deal of the carbon is lost as carbon dioxide (CO_2), which is eventually released to the atmosphere.

The proportion of carbon that is lost as CO_2 will be higher with very easily degraded materials low in lignin and high in nitrogen. These materials primarily enhance short-term bacterial activity. Fungal activity is often slower to develop, and is more active on relatively high C:N and lignin-containing material. Fungi, more so than bacteria, produce physical structures and chemical compounds that bind soil aggregates and serve as base units for humic substances.

SOM should be preserved by minimizing oxidative carbon loss. Two management factors that seem to increase soil oxidation and CO_2 release are intensive tillage and fertilization. Minimizing the frequency and intensity of both tillage and fertilization help to keep the soil habitat and community stable and maintain SOM.

Low-outside-input and organic farms are more dependent than conventional farms on their inherent soil fertility. Maintenance of the soil's native nutrient supply and cycling is dependent on maintenance of rich and diverse SOM and soil biota. Focusing on these factors is an important step to sustainable farm management. ✪

SPEAKER PROFILE

***Lynne Carpenter-Boggs** is a soil microbiologist at the USDA-ARS in Morris, MN. Her research concerns changes in soil microbial communities, processes, and soil organic material in response to agricultural disturbances and amendments; decomposition and management of farm wastes; characterizing microbial and soil quality parameters in high quality soils; sustainable agricultural management and alternative microbial soil amendments. In 1991 she earned her BS Magna Cum Laude in Biophysical Environmental Studies, Northland College, Ashland, WI.; in 1994 she finished her MS in Soil Science (Soil Microbiology and Biochemistry), at Iowa State University, Ames, IA.; in 1997 she earned her PhD in Soil Science at Washington State University, Pullman, WA.*

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BIODIVERSITY IN SOIL: INTERACTIONS WITH AGRICULTURE AND THE ROLE OF AGRICULTURE IN PROBLEM-SOLVING

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Soil is an astonishingly complex habitat. Soil is only approximately 50% solid matter. The remaining 50% of soil space is filled with air and water. A rich mollic topsoil with 5% organic matter (OM) will have around 7.5 tons of organisms per hectare. Of this, approximately 6 tons will be microbial (bacteria, actinomycetes, fungi, algae, protozoans, and other microscopic life). Of the soil mesofauna, some of the dominant groups are mites (100,000 per m^2), earthworms and pot worms (up to 20,000 per m^2), and nematodes (up to 1 billion per m^2). It is the microbes that dominate, though. In one gram (a small pinch) of rich topsoil, there may be a billion bacteria and one hundred thousand fungi, not to mention the other groups present in the thousands and millions. Soil supports such a massive biota because it provides many habitat niches that vary in scale, aeration, pH, and nutrient status.

Because so much of the soil life is microscopic, and even that which we could see is hidden from view by the soil itself, relatively little is known about the soil biota. It is thought that most of the mammals on earth are known and classified. There may be a hundred or so undescribed fish. Estimates of plant species vary, but likely we have described most of them. But probably only 30% of nematode species have been identified, and less than 5% of fungi. Bacteria do not mate in the ways of larger organisms, so that it is difficult to even define a bacterial species except by relative similarity. Likely, we have only characterized a few percent of all bacterial species, and a fraction of a percent of all unique strains. It can be said that the proportion of unknown organisms in soil is rivaled only by pristine tropical rainforests.

The diversity of the soil biota is now recognized in general terms, but poorly described. Besides the physical barriers to studying soil life, our chemistry and science have lagged behind our needs in this area. The most common method in microbiology, the isolation and pure culturing of the organism, is rarely successful for soil organisms. Many will grow on agars and growth media, but many more will not. With the advent of direct counts, metabolic tests, and DNA analysis, it has become apparent that only a small proportion of the soil microbiota is culturable by traditional means. Perhaps as many as 10% of soil microbial species have ever been cultured, but it is thought that generally 0.1 to 1 % of all viable cells are recovered in a soil microbial investigation. Other methods have their own problems, including difficult quantification and incorrect identification.

One method gaining favor is the use of metabolic abilities or substrate utilization. Biolog™ plates provide 95 substrates. A single isolate or a weak dilution of a soil sample can be inoculated into all 95 wells with a color indication of microbial use of each compound. In this way, one kind of community diversity can be described. DNA can also be used to indicate the overall genetic diversity of a community. DNA will "melt" or separate into single strands, at high temperatures. If the temperature is decreased again, the DNA will re-anneal or form double strands again. The speed with which pieces of DNA will reassociate depends on their similarity. This similarity can be analyzed by the DNA's absorption of UV light, which is much greater for single DNA strands than double strands. The longer it takes the DNA pieces to reassociate, the more genetically diverse was the community from which the DNA was extracted. Using this technique, Torsvik et al. determined that a sample of around 100g dry soil contained 4,000 completely different bacterial genomes. Because different species of bacteria have about 70% similarity in genomes, the 4,000 complete genomes could have come from over 10,000 species, and hundreds of thousands of strains of bacteria.

Why should we be interested in soil biota? Many of the basic processes that support plant and animal life on earth are mediated by soil organisms. Soil would not be soil without them. Soil life is responsible for decomposition of dead organic material. This decay process also makes possible nutrient cycling and humus formation. Humus gives the soil its dark color, rich smell, crumbly texture, and long-term fertility. These decay and cycling activities are one of the ways that soil biota support plant growth. They also fix nitrogen into plant-usable forms, supply phosphorous to plant roots, and help to release unavailable inorganic nutrients into available forms. The vast majority of soil biota can be beneficial to crops, and can even reduce the incidence of pathogenic infections.

Soil biota physically and chemically stabilize and form the structures we recognize as soil. Their bodies and byproducts are woven throughout the mineral soil matrix to form soil aggregates. The soil biota, then, should not be thought of simply as inhabitants of the soil habitat, but as an actual inextricable part of natural fertile soil, responsible for digestion and breathing of the soil body. A textbook on biodynamic agriculture by Sattler and Wistinghausen put it this way, "Soil organisms do not constitute the life of the soil; they are the actual organs of a living organism."

Biodiversity is particularly important in sustainable and organic farming, and the opposite is also true. Sustainable and organic farming are particularly important to biodiversity. Sustainable agriculture is defined as a system that maximizes inherent soil productivity with minimal inputs, especially of off-farm, non-regional, and non-renewable materials. Sustainable agriculture must preserve the environmental benefits of the land while producing sufficient high-quality farm products. Sustainable agriculture must also be environmentally sound, socially just, and economically profitable.

It is important that the abundant life of soil be diverse because the tasks and challenges it must meet are also diverse. These organisms must be symbionts to diverse plants. The root exudates that serve as food and molecular signals to symbionts can vary among varieties, as well as among species. Diverse residues, other organisms, and even man-made substances are potential food sources. The varied abilities of microbes prevent many potential pollutants from reaching groundwater or remaining in our environment. Their diversity is the source of diverse antibiotics and different methods of fighting pests. Biodiversity also makes the soil community resilient to disruption. If and when the environment changes, biodiversity serves as a resource pool of organisms that may survive or thrive in the changed habitat.

Many of the 20th century agricultural technological advances have negatively affected biodiversity on farms. Larger and larger fields have been dedicated to monocrops. Even whole regions now share the same short-term rotations of one, two, or three dominant crops. Often only a handful of varieties cover the acreage of several states. In an effort to lessen the detrimental effects of increasing pest problems, broad-spectrum pesticides, herbicides, and fumigants have been used on large acreages. These toxins select for the organisms most tolerant to them, pushing out not necessarily the target pest, but whatever the most sensitive species. Changes in crop varieties and the extensive use of fertilizers have both selected for crops that exude far less photosynthate from their roots and favor crop use of readily soluble nutrients instead of nutrients made available through symbiotic relationships. This provides no niche for microbial symbionts. Some former symbionts have been relegated to tiny patches of native habitat, while others have become more parasitic in order to survive in their new environment.

However, there may have also been some positive recent pressures on soil biodiversity. One interesting result of the massive application of new chemicals in ag fields is that a large proportion of soil microbes have developed and shared abilities to degrade these previously unknown compounds. Genetic engineering of crops is creating genetic combinations previously unknown in nature. It is also difficult to argue that the spread of "green revolution" technologies has resulted in a tremendous production of farm products. Some argue that only through the most intensive use of farmland can we preserve pristine areas for wilderness and enhanced biodiversity.

The difference between moth diversity in agricultural and forest lands can serve as an indicator of many other groups. Forests are consistently found to support greater moth diversity than the agricultural fields that have replaced forest in many areas. This is because biodiversity depends on habitat diversity. Forests provide many more levels of niches, from soil to leaf litter, ground vegetation, tree trunks, to a varied canopy. Agricultural fields are usually simpler, only providing soil, minimal residue, and crop stalk and canopy of one or two species.

Still, biodiversity can be enhanced in agroecosystems by consciously enhancing habitat diversity and permanence at many physical levels. Even within annual crop-based agroecosystems, biodiversity becomes greater (and pest buildup is less likely) with rotations or mixed cropping. Inclusion of legumes and intercropping help to create more diverse habitats, supporting more biodiversity and suppressing the dominance of any one insect. We can choose to create and support productive systems that follow a different model than the current monocrops. Crop, faunal, and overall genetic diversity increase in the sequence from monocultures, to orchards, organic farms, and traditional polycultures. More diverse systems, again, support a greater level of natural pest control.

The level of biodiversity supported by an agroecosystem is affected by farm management choices. More biodiversity will be found with a greater diversity of vegetation both within cropped fields and in surrounding areas. Perennial crops and continuous ground cover can increase biodiversity by providing year-round habitats. Decreased intensity of outside farm inputs is usually correlated with increased biodiversity. This is partially due to direct effects of pesticides, and partially due to indirect or related effects of high-input systems that tend to be short-rotation monocrop systems.

One of the most critical factors in maintaining high biodiversity within the soil habitat of agroecosystems is the maintenance of high quality soil. As described earlier, soil quality and the soil biota are intrinsically linked. While the soil cannot reach full productivity without a healthy soil biota, so the soil biota cannot reach full biodiversity without attention to overall soil quality. Rich soils are needed along with a diverse array of crops and animals as substrates and symbionts. Diversity among farms will be greatest if locally appropriate cropping and livestock systems are developed instead of applying "one-size-fits-all" agriculture to naturally diverse regions.

Comparisons of whole farms commonly show organic and low-input farms to support greater levels of floral and faunal biodiversity than conventionally managed farms. Comparisons of the soil biota diversity on organic and conventional farms have varied in result. Particularly when conventionally managed farms maintain diverse crop rotations, overall soil biodiversity also is maintained. To preserve off-farm habitat for biodiversity, organic and low-input farms must remain highly productive. While agricultural systems are available and more can be created that enhance on-farm biodiversity, agriculture also must support the preservation of non-agricultural areas. The greatest biodiversity results from the greatest diversity of habitats. No agricultural ecosystem alone can support the maximum biodiversity of a region. Mixed and varied habitats are needed, and for some species these must be large intact areas. To preserve these areas, human populations must be supported by productive agriculture. If we convert all agricultural land to certified organic production, yet this land does not meet our needs, more land will be tilled. This will decrease total biodiversity. Agricultural management may also be the most efficient method for sustainable production of fuels and building materials that are currently harvested from fragile ecosystems.

One should note that this argument is used by Dennis Avery and others to argue against all organic and low-input production practices. The argument states that only high-input agriculture can be highly productive, and only the most productive agriculture can preserve the most land area for non-agricultural uses and biodiversity. While persuasive, this argument ignores several facts, such as the greater biodiversity found on organic and sustainable farms, the fact that low-input farms can be as productive as high-outside-input farms, and the current disconnection between human needs and agricultural production. That is, agricultural production today actually exceeds human needs, but land is not reverting to native habitats. Some people still go hungry because of transportation costs, political unrest, and social inequity, while "excess" product is fed to livestock and used to build political relations.

Conversely, the human population and its resource use must balance with the ability of our agroecosystems to produce those resources. In the 20th century we have seen a global explosion in the human population. This is partially the result of increased agricultural production. Negatives in the population equation, or many causes of death, have declined due to better nutrition and economic access to a healthier lifestyle. All of us alive and well today can be thankful for this. However, agriculture is not a limitless industry. Regardless of the productivity of any system, every system does have a limit. This does not seem to be the case with the human population, which can double every 20 years. Conversations on biodiversity and sustainability are moot without a goal and plan to limit the human population and its resource use to a level that fits the sustainable productivity of the earth at current and future technological levels. Technology will advance our productivity and efficiency, but we cannot assume that it can double every 20 years ad infinitum.

This is of course a problem, and solution, beyond the scope of agriculturists. Several other actions by policymakers can help to preserve and enhance biodiversity of and through agroecosystems. Biodiversity is valuable to us for many reasons, but most of these reasons are unknown to the general populace. Most people are and must be utilitarian. Biodiversity will be most appreciated and best served if its benefits are utilized and publicized. In other words, "Save it, know it, put it to use." This is particularly true with microorganisms. The fight to save various forests, grasslands, coral reefs, etc., has been helped by describing the plight of a few unique or beautiful species, i.e. "charismatic megafauna," such as pandas and spotted owls. Microbiologists need to find and focus on a few "charismatic microfauna" to expand the attention of biodiversity advocates to the soil.

One of the primary goals of biodiversity-related policy must be education. We all must realize that global biodiversity is an international public resource. Resources are worth preserving, for ourselves and for future generations. We all will need access to the products of biodiversity around the globe, and we must be willing to pay for it. ✪

SPEAKER PROFILE

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ROLE OF FORAGES IN SUSTAINABLE AGRICULTURE

— ZOHEIR ABOUGUENDIA —

MANAGER,
GRAZING AND PASTURE TECHNOLOGY PROGRAM

Abstract

In this paper I discuss some of the potential forage opportunities and benefits for Saskatchewan. I further identify the challenges that must be met to successfully realize those opportunities and benefits. The opportunities include including perennial forages in crop rotations, producing hay or silage, producing tame and native forage seed, grazing by livestock, providing habitats for wildlife, protecting water ways and sequestering carbon as a mitigation measure for reducing carbon dioxide levels in the atmosphere. The presentation will focus on the benefits from including forages in crop rotations and growing forages on marginal cropland, mainly for livestock production. Including forages in the crop rotation has many environmental and economic benefits that are well documented. Successful addition or conversion to a forage-based enterprise requires a comprehensive planning process. Such a process must take into account the unique goals and resources of each farm. A sustainability gradient is used to estimate the relative degree of sustainability of a number of forage-related enterprises and practices. It was concluded that forages can contribute significantly to both ecological and economic sustainabilty of Saskatchewan agriculture.

Introduction

In this paper I will identify some of the potential forage opportunities and benefits for Saskatchewan. Because of time limitation, I will focus in particular on two areas: inclusion of forages in crop rotation and forage-based livestock opportunities. I will further identify the challenges that the producers will face when attempting to add or convert to forage-based enterprises. The paper will identify approaches and practices that will help improve the opportunity for a successful change.

For the purpose of this presentation, the relative sustainability of some of the approaches and practices discussed will be estimated using a sustainability gradient. The relative sustainability depends on the amount and kind of inputs employed. For example, the wheat-tillage fallow cropping system is located near the least sustainability end of the gradient because of its high agronomic inputs (e.g., fossil fuel, and fertilization) and the high potential for soil erosion resulting from tillage. A properly managed native range, on the other hand is located near the most sustainable end of the gradient because it is ecologically managed with a high degree of reliance on natural physical and biological inputs.

Selected Forage Opportunities

Forage crops represent many opportunities for Saskatchewan agriculture, including:

- Crop - forage rotation
- Livestock grazing (e.g. cattle, sheep, bison, elk, goats and white-tailed deer)
- Hay or silage production
- Tame and native forage seed production
- Wildlife habitat
- Waterway protection
- Carbon sequestration

The role of forages in crop rotation and forage-based livestock enterprises will be discussed later in separate sections. Hay is produced for on-farm use or for off-farm sale. Local hay markets deal mainly with relatively low-priced, medium or low quality hay suited for wintering cattle. A small amount of hay is exported in the form of processed forages (e.g. alfalfa pellets) or long-baled hay (e.g. timothy) and usually bring relatively high prices. The export market is classified as a niche market. The annual Saskatchewan hay production ranges from 2 to 4 million tons, making Saskatchewan the fourth largest hay producer in Canada.

At present, about 35,000 acres are used for forage seed production in Saskatchewan. The seed is produced for the Canadian market as well for export to the U.S. and other countries. There is an opportunity for an increase in the demand for forage seed as a result of the increased interest in converting cropland to forages in recent years. Tame forage seed production constitutes the biggest proportion of the market. Native forage seed production represents a very small but growing portion of the market. Again forage seed production is considered a niche market with an average annual income of about $5 M.

There has been an increased interest in wildlife habitat enhancement in Saskatchewan in recent years. Some producers have recognized that fact and have entered into partnerships with conservation organizations such as Ducks Unlimited Canada (DUC). For example, DUC is now working with Saskatchewan producers on 364,000 acres involving delayed hay, conversion to pastures, grazing systems, stock-water development, or fencing. It is expected that wildlife habitat will assume even greater importance in the years to come.

Carbon sequestration refers to capturing carbon dioxide (CO_2) from the air by plants and storing it in or on the soil surface. CO_2 is one of the greenhouse gases implicated in global warming. Some utility companies have started paying for carbon sequestered by forages and trees to use as a credit towards reducing greenhouse gases.

Old stands of forages show greater plant species richness than cropland. This increase in plant species diversity is often associated by increased diversity of other organisms.

Role of Forages in Crop Rotations

Including forages, particularly legumes, can have many economic and ecological benefits. Crop-forage rotations often result in greater crop yield, even when compared to rotations involving legume crops such as field peas . We find that the uptake of nitrogen by the crop increases as a result of alfalfa-crop rotation. The increase in yield has also been confirmed at the farm level in producer fields (Entz et al, 1998).

According to a survey of farmers in Saskatchewan and Manitoba, perennial forages in crop rotations can improve weed control for at least two years (Figure 4). One third of the producers indicated improved weed control for three years. Including forages can, therefore, reduce the need for herbicides and tillage for weed control.

Alfalfa rotation can increase the nitrogen supply power of the soil during the crop phase of the rotation. This often means a significant reduction in nitrogen fertilization requirement during the crop phase.

Our cultivated soils have lost on average about 50% of the original organic matter found in the native grassland prior to cultivation. Perennial forages invest a great deal of energy in elaborating underground systems. This means increasing soil organic matter content. The increase in soil organic matter will help improve nutrient status, water holding capacity and soil's capacity to buffer against loss of nutrients.

Forages in crop rotations result in improved soil structure. For, example, hay in a wheat rotation increased the water-stable aggregates. This means greater resistance to soil erosion by water. Modeling studies showed a reduction in water and wind erosion in both fine and coarse textured soils. Although the benefits from reduced water erosion is greater in the fine textured soils (Swan River Plain) and the benefits from wind erosion is greater in the coarse-textured soils (Whitesand Plain).

In the long-term, it is estimated that carbon dioxide emissions from crop forage rotations can be expected to be lower than other rotations. Thus, forages can contribute to reducing greenhouse gases.

Forage-Based Livestock Production

A very important fact to remember is that we still have about 5 million acres of physically marginal, and likely economically marginal, land used for cultivation of annual crops (PFRA, 2000). Physical limitations include soil erodibility, soil salinity, poor drainage and site dryness. Marginal cropland has lost a great deal of the original organic matter, making it even more unsuited to crop production.

Forages offer a more environmentally and economically friendly land use. Forages have a much wider range of adaptation to the above physical limitations than annual crops. For example, there are forage species, such as tall wheatgrass and altai wildrye that tolerate much greater levels of salinity than even the most salt tolerant crops. There are species of forages, like alfalfa, that have the ability to control salinity when planted in recharge areas. They have deep roots and they consume large amounts of water. Water is the agent of salinity carrying salts to the discharge sites.

Land too poor in quality or marginal for other reasons can be used for human food production using ruminant livestock. In addition to utilizing the inexpensive and environmentally friendly fiber, the ruminants will help improve ecological processes such as nutrient cycling. This is because most of the nutrients ingested by livestock goes back to the pasture system and can be reused by plants. Very little of the nutrients is actually retained by the animals. The deposited excreta with the nutrients it contains will help enhance nutrient cycling.

On marginal cropland, livestock has shown to be more economically viable than grain crops as shown from a trial in southwestern Saskatchewan. Return to labor and land was greater from yearlings than wheat in most years. Another study in North Dakota showed even more drastic differences. On better quality land, livestock may achieve similar or slightly lower returns, depending mainly on the kind of crop, input cost and product price.

The Challenges

Adding or converting to a forage-based enterprise is a major challenge for crop producers and the change in itself does not necessarily ensure success. The change will require additional investment for forage seeding, stock-water development, fencing and other facilities, and acquiring livestock. It involves a major change in life style, particularly if livestock is included. Such a change requires a long-term commitment.

Livestock producers have to live with the cattle price cycle. To do that successfully, requires a full understanding of the cycle, planning and monitoring the markets. Also, livestock producers have to deal with drought. Drought in this case is more than a crop failure, the animals must be fed and watered, moved to non-drought areas or sold. Furthermore, improper grazing management practices may still cause significant soil erosion, adversely affect water quality and jeopardize pasture sustainability.

While grain crops are marketed by the wheatboard, forage and livestock producers must assume a greater role in marketing their products. This is particularly important in the niche market products such as organic beef, export hay, and forage seed. So, how to make forage opportunities economically and ecologically sustainable? This is the subject of the next section.

Meeting the Challenges

Land-use change decisions must be based on planning that takes into account the producer's goals as well as his own land, human, water, cultural and financial resources. Various alternate enterprises must be evaluated based on the best information available. Help can be obtained from family members, neighbors, and professional agrologists. Planning is an on-going process and plans may need to be modified as a result of enterprise performance monitoring or change in the economic environment.

To help achieve the desired benefits and synergy from forage-based enterprises, there is a need to integrate those enterprises into the whole farm operation, including crop production. The traditional mixed-farm model may need to be re-examined for a greater farm-level integration. The farm level integration will increase cash flow diversification and thus reduce financial risk

Also, it appears that there is a need for a community-level integration (e.g. through cooperatives involving grain producers and livestock producers within the community). There are opportunities for sharing risks and profits among the members of co-ops. Many annual crop producers may be willing to seed a large proportion of their farm to perennial forage, but they do not want to be in livestock or do not have livestock enterprise manage-ment experience. Also, some grain producers may want to include forages in their rotation but are not able to find markets for their hay due to cost of transportation. Arrangements with local livestock producers may help solve such a problem. In addition, a question that needs to be answered is: is there a room now for privately-owned 'community pastures?' The waiting list of people wanting to get cattle into the provincial and federal community pastures is quite long.

As mentioned before, forage-based enterprises require a greater attention and involvement in marketing. This is particularly essential for niche market products such as organic beef, export hay, and forage seed. Marketing strategies must be developed. Such strategies must be based on knowledge of current market needs, product standards, present competition and projected product demand. Many niche successful market producers established their clients by developing a reputation as a reliable supplier of high quality product.

The forage-based enterprises should be looking for ways to reduce input costs. For example, including a legume with the grass will help reduce the cost of pasture fertilization. Including alfalfa with crested wheat grass resulted in an increase in forage production similar to that of adding about 90 lb/acre of nitrogen.

Other ways to reduce input cost include swath grazing and stockpiled perennial forages. Swath grazing of annual cereals can achieve cost savings compared to green feed. Swath grazing is considered as a transitional stage prior to conversion to perennial forages. Use of farm residue such as straw and chaff is another technique.

Ammoniation of chaff and straw can help improve their nutrient quality substantially according to research carried out in the Saskatchewan Research Council under Dr. Ewen Coxworth.

Producer must also consider other recent advances that may help reduce cost or improve efficiency such as new developments in electric fencing, stock-watering systems and grazing management of alfalfa and management-intensive grazing.

Conclusions

There are many forage opportunities available for consideration by producers. Forages can contribute significantly to ecological sustainability of Saskatchewan agriculture through soil & water protection, soil improvement, better nutrient cycling, reduced greenhouse emissions (less fossil fuels, chemicals & machinery), carbon sequestration, increased biodiversity and enhanced wildlife.

Overall, including or increasing forage enterprises will move agriculture along the sustainability gradient towards greater economic and ecological sustainability. Forages can contribute significantly to economic sustainability of Saskatchewan agriculture through providing a viable land use alternative for marginal cropland, increasing farm return, reducing the dependence on costly inputs (e.g. fossil fuels, chemical fertilizers, pesticides & machinery), increasing income diversification (reduced risk) and improving utilization of farm resources and products (straw, chaff, manure, etc.).

Proper long-term planning is essential for a successful addition or conversion of forage-based enterprises. Emphasis must be placed on input cost control. The plan must be based on the goals and available human, land and financial resources of each farm. Product marketing strategies should be developed. Forage-crop-livestock integration will need to take place at the farm and community levels to achieve economic synergy. ✪

APPLE PRODUCTION ON THE PRAIRIES: IT CAN BE DONE

— RICK SAWATZKI —

I recall speaking about this recently and asking the question, "Can it be done?" Now we know, "It can be done," and some are saying let's do it.

Today I need to wear more than one hat. I like hats; I need hats. You can see why.

Since I'm here speaking to you in place of Craig and Yvette Hamilton, the Farmer/Producer hat is appropriate.

I'm talking about profitable production that is designed to meet the needs of the local market. These are medium sized orchards. They are part of a larger farming enterprise. It can be done because it has been done, and not only just recently but prior to 1950. The Wheeler, Heyer, Heaver, McCloy and Neufeld orchards all grew crabapples and apples on a significant acreage and made money selling the fruit. I heard reports that some people would travel for hours to buy fruit from these producers.

More recently, Gord Howe at Indian Head, Craig and Yvette Hamilton at Radisson (11 acres of apples) and others are doing the same.

Twelve growers have at least 500 trees each ordered or established and 19 growers each have between 50 and 499 trees. An equal number are seriously interested. Most are organic growers. Some growers have moved here from BC where they leased or managed orchards. They couldn't afford to buy land there at $30,000 per acre.

So you can see that it's small but growing, just like saskatoons were 15 or 20 years ago.

Apple Cultivars and Selections

Agriculture Canada, Morden, MB has led the Prairie Fruit Breeding Cooperative Program since 1950. The apple cultivars: Norland, Westland, September Ruby and Norkent were introduced. These are all good apples that combine better quality and more winter hardiness. The University of Saskatchewan released SK Prairie Sun two years ago.

Production

The University has tested Ottawa #3, a dwarfing apple rootstock, which produces a tree 25% of normal size. We are now testing efficient high-density production systems on a large scale (the Hamiltons have planted between 500 and 600 trees per acre). These systems have been used for some time in the advanced apple producing areas of the world but are new here.

The disease and pest pressure here is lower. Organic production is much easier. However, our weather can be very hazardous.

Markets

The strength of the local market is surprising us all. If Craig and Yvette were here they could talk at length about their marketing experiences; all positive. They told me that they could sell their crop many times over. Wholesale and retail stores are asking for fruit. People are coming to them. They spend very little on advertising. They are willing to share their customers and their web site with new growers and are very helpful in many other ways. Their web site is www.prairieorchards.com

Summary

1) There is a history of apple growing in Saskatchewan.
2) Our fruit quality is very competitive now.
3) Production costs are probably lower - more data is needed.
4) The local market is very strong.
5) Using our experimental production systems and/or the advanced apple selections is still somewhat risky.
6) Our weather introduces more risk of cold temperature damage and wind damage to the trees than in other areas but helps control insect pests and diseases.

Plant Breeder's Hat

The basic breeding objective was to combine winter hardiness with good fruit quality. This was an incremental process taking approximately 15 years per increment or generation. The generation time is a few years shorter now due to new techniques. Compare a generation time of twelve years for apples with the six month generation time for grain and you'll see why it is taking so long to develop good, well-adapted apples for this area.

Have we met our objective? Are we there? If not, we're so close! In a few years you may hear someone saying that we made it.

At present, 53 advanced selections are being tested and one, 18-10-32, will be named and introduced soon.

More crosses were made in 1999 and 2000 and these should lead easily to the introduction of cultivars that will be among the best in the world.

In addition to fruit cultivar improvement, breeding and selection work is being done to develop a series of hardier clonal rootstocks for the prairies.

Growers from Fairbanks, Alaska to Sault Ste. Marie, Ontario have requested to cooperate with us in maintaining test sites. At present most of our test sites are in Saskatchewan with some in Alberta. There is a good chance that test sites will be established in Manitoba and northern Ontario. ✪

INTERCROPPING TO BALANCE SOILS AND PESTS ON ORGANIC FARMS

— JANINE GIBSON —

CREATIVE HEALTH CONSULTING

As an organic inspector I have gathered the following information over the past 9 years from having conducted over 900 inspections for 12 certifiers, on over 500 organic farms. Please accept this as anecdotal research and conclusions. Since this presentation, this information has been published in the second edition of the Organic Field Crop Handbook, published by Canadian Organic Growers.

Nature loves Diversity! Developing diverse intercrop rotations that fit specific farm operations does a lot besides avoiding soil and pest problems. Farmers need to use all the resources they have to build nutrient cycles and balance soil ecology. In this effort toward balance, an Eisenhower quote is appropriate, "plans are useless, planning is essential." This is true in farming because weather, market and other pressures often interfere with crop rotation plans. Successful organic farmers usually have plan A, B and C depending on the weather, equipment availability, soil condition and economic needs. Plans usually have to change, putting great emphasis on the process of planning.

Crop/Intercrop Rotation Principles

These include rotations of the three basic crop types: Grasses - wheat, oats, barley and rye; Broadleaf's - flax, canola, mustard, buckwheat and sunflowers; and Legumes - alfalfa, clovers, peas, lentils, beans and medics (of course inoculated with the appropriate bacteria for nitrogen (N) fixing). These are usually grown in succession rather than intercropped, with 40% of organic farm acres in legumes to maintain N levels. This statistic comes from recent research in Manitoba by Dr. Martin Entz who also indicated that organic farmers rely less on tilled fallow; only 6% of the land in the survey used fallow over the 5-year study period. Ensuring that 40% of the crops were legumes maintained N levels adequately but phosphorous (P) and sulfur (S) levels were inadequate to the point of limiting yields. Dr Entz has stated that more research, and on farm experimentation with intercropping is needed. Early and late germinating crops need to be alternated in rotation planning, while intercropping requires that plant needs be similar when they are to be grown together on the same field. The length of growing period required for maturity is crucial along with relative seed size, so though harvested together, the field crops can be separated for use. It is also important to know what nutrient levels are in your fields. If you are starting with low P levels a green manure crop of buckwheat either as a winter cover or summer smother crop can make both P & potassium (K) more available to following crops. In a manner similar to how mustard and canola can accumulate S through root hormones released into their taproot zone, buckwheat roots acidify their root zone area. This appears to promote the growth of bacteria that predigest P & K and by so doing makes these nutrients more available to following crops.

Interseeding biennial sweet clover with cereals is the most common, successful organic practice to establish the clover as both a green manure and a saleable crop. The other most common examples I have observed in the last few years of my inspection tours include oats and peas or lentils, flax and wheat and/or clover/medic, canola and barley and/or peas with increasing use of rye and buckwheat for improved weed control and organic matter. Certified organic producers require their own cleaning facilities or a certified organic cleaner, to separate the products for use. Often, the small scale, on farm or mobile cleaning units can do a superior grain-cleaning job; operator skill is important here. If you are just learning about working with peas, lentils and beans be sure to modify equipment and speeds to prevent cracks and splits as these reduce the value of these high end organic crops. Know what your buyer needs in terms of quality and include those guidelines in your planning.

Oats/Peas/Lentils

With this cereal/legume combination the allelopathic root hormones of the oats help control weeds in the less competitive pulses. The oats use magnesium (Mg) that the pulses leave available to the waiting wild oats. As well Sclerotia, the over wintering structure of sclerotinia (which causes stem rot and white mold) can live in soils for years awaiting the right conditions. The pulses climb up the oats, creating better air movement, which appears to prevent the white mold growth. The legumes are also easier to harvest up off the ground. The oat trash leaves better soil cover than the pulses alone, encouraging the destruction of pathogens by beneficial fungi and bacteria. Learning to grow the more valuable peas/lentils/beans with oats increases the per acre income on organic farms and connects the familiar practice of growing cereals with the often unfamiliar practice of a range of pulses. Any shattering of the pulses leads to beneficial re-growth.

Flax/Wheat/Clover/Medics

Flax is a very valuable organic oilseed that has the undeserved reputation of being hard on the land. It is thought to be a relatively low N feeder, needing good P & K reserved for its fibber and flowers. Weeds often take advantage of the available N. When seeded with wheat, the flax is protected from weed competition because the wheat uses the N. The flax straw being removed or burnt is what is hard on the soil. When intercropped with wheat, the flax is much easier to cut and combine. The wheat also anchors the flax in the swath so it doesn't blow. The cereal also appears to limit sclerotinia problems in the flax. Beneficial soil bacteria populations are built up by digesting the wheat straw. These increased populations break down the flax straw more effectively. Seeding rates vary greatly with bioregions. It has been observed that the protein levels in the wheat are often reduced somewhat. This is usually compensated by the high per acre value of the flax. I recommend following this intercrop with rye and buckwheat green manure's to ensure P & K availability. Snail medic and black medic are reseeding, N fixing legumes that are low growing, drought tolerant underutilized understory crops.

Canola/Barley/Peas/Lentils

Canola attracts flea beetles and diamond back moths while not returning much carbon material to the soil. It and the mustards do accumulate sulfur helping to maintain a healthy S:N ration. My theory for controlling wild mustard is to grow these sulfur-accumulating crops so they can do for the soil what the wild mustard is doing. When intercropped with barley, the barley appears to disguise the canola from the pests, greatly reducing damage. Dr. Jill Clapperton of the Lethbridge Research Station recommends 10% barley for this effect without reducing canola yields. I have heard and seen much greater seeding rates being effective. The barley helps control weeds, especially in spots where the canola doesn't catch, and returns more carbon material after harvesting. It also anchors the swath well so there is less blowing. The legumes fix N, helping to keep the S:N ratio in balance.

Production Methods

Seed placement, seeding rates and field work techniques all vary with bioregions - soil types, moisture levels and available labor and equipment. Generally, farmers reduce their local rates by one third for each crop and plant them together at the higher total rate, which is common for organic production. This is very effective for weed control and moisture conservation. Rather than compete for moisture, the ground is shaded from the sun's ultra violet rays so less moisture is lost to evaporation. Harvesting procedures are also modified with skilled sieve settings on the combines. Experiment with what already works for your operation and what seems to make sense in your circumstances. Nature loves diversity and rewards us for our careful observations and experiments. ✪

SPEAKER PROFILE

Janine Gibson was trained as a professional Human Ecologist. In her business Creative Health Consulting, she has worked in the organic movement as an inspector, speaker and consultant since 1993.

She is an accredited member and training coordinator with the Independent Organic Inspectors Association, teaching at international organic training events. She has also instructed organic farming basics through Assiniboine Community College of Brandon, Manitoba along with the ACC Organic Inspection Course.

Janine has conducted over 900 organic inspections across the great plains of Canada and the US, for 12 different certification agencies. Her work on the prairies is to promote balance in our soils, our bodies and our communities through organic production and consumption. She lives in a solar powered community in south east Manitoba, Northern Sun Farm Cooperative.

ECONOMICS, ECOLOGY AND SUSTAINABLE AGRICULTURE

— DAVID GRANATSTEIN —

CENTER FOR SUSTAINING AGRICULTURE AND NATURAL RESOURCES,
WASHINGTON STATE UNIVERSITY,
WENATCHEE, WA U.S.A.

When I spoke at this conference last year, I presented various scenarios comparing organic farms to conventional ones. Hart Haidn asked me to speak today on the subject of economics and sustainable agriculture. The term sustainable agriculture is generally defined as economically viable, environmentally sound, and socially equitable. While short-term profitability is essential to maintain a farm, judgement of economic viability must also include long-term considerations. Often these relate to various environmental and social costs or benefits from a given production system that are not factored into profitability analysis. Over the past decade, a new discipline called ecological economics has emerged to try to reconcile some of the difficult and seemingly intractable conflicts between economics and ecology. My comments reflect some of that discipline's findings, along with the results from a unique long-term dryland farming study and my own experience in agriculture and environmental science.

World View

Several speakers yesterday referred to paradigms, or a world view. What is our world view of the nature of the "economy?" We all know the expression "money makes the world go 'round." This implies that the economy is the main system we live in, and that the earth, or ecosystem, or biosphere, is a subset of the economy. But ask yourself the questions – Can there be an economy without earth? Can there be earth without an economy? I believe the nature of the economy as a subsystem of the larger ecosystem is self-evident. Given that, then the laws of nature are paramount and economic matters must function within those laws. However, economics as we have known it for the past century or more has done just the opposite.

In Table 1, I illustrate how an "economic" world view might contrast with an "ecological" world view. In addition, a "social" world view could be developed to highlight this aspect of sustainability, but this is beyond the scope of this presentation.

TABLE 1:

The 'Economic" World View

- Based on perpetual growth
- Linear, flow through
- Short-term thinking
- Usurps natural capital
- Ignores non-monetized values
- Markets will dictate 'best" solutions

The 'Ecological" World View

- Recognizes limits
- Based on cycles and renewal
- Long-term thinking
- Maintains natural capital
- Everything is interconnected
- Based on physics, biological relationships

Depending on which view a person holds, the approach to analyzing economics would be drastically different. A fundamental problem becomes apparent if one accepts the ecological view in which limits are recognized. This is in direct conflict with the principal of perpetual growth that underpins the economic world view. Herman Daly in his book *Beyond Growth* distinguishes between sustainable growth (which he considers impossible) and sustainable development (which implies improvement of quality of life without increased physical output). Daly refers to the work of economist Nicholas Georgescu-Roegen who wrote a book called *The Entropy Law and the Economic Process*. He outlines two categories of energy or resources upon which economic activity depends. The *solar source* represents current solar energy. It is stock abundant (the sun will shine for millions of years), but flow limited (only so much solar radiation strikes earth each day, and we cannot change that). The solar source is the basis for subsistence agriculture economies, which live on current solar income or renewable energy. The terrestrial source represents non-renewable energy such as coal, oil, and gas. This source is stock limited (as far as we know, there is a finite amount on earth), but flow abundant, since we can decide how much to extract ourselves. The terrestrial source is the foundation for industrial society and modern intensive agriculture. In a sense, Georgescu-Roegen is suggesting that energy is a more fundamental currency than dollars, a concept that I have also proposed. Since energy and dollars are not closely coupled in our economic system, we have a potential problem in terms of long-term sustainability.

The entropy law states that the tendency of the universe is from low entropy (order) to high entropy (randomness, waste).

Biological systems are effective in reversing the entropic flow, while many industrial systems increase entropy and create waste. Daly proposes that increasing depletion and pollution are necessary consequences of economic growth in the industrial model, and should come as no surprise. They represent a shift from a low entropy system (solar stock) to a high entropy system (terrestrial stock). He disputes the neoclassical idea that we can escape resource constraints of the entropic flow by substituting capital for resources.

Measures of Success

How we measure success, both as individuals and as a nation, can have a profound impact on what we learn from the past and how that guides our current and future actions. A key macroeconomic indicator that has been used throughout the industrialized world to measure economic success is the Gross National Product (GNP). This figure sums all the goods and services produced within a national economy. Both "good" expenditures and "bad" expenditures are added together. For example, the value of cars manufactured is added along with the costs of air pollution and injuries from accidents. In agriculture, the GNP would include the value of wheat produced and the cost of cleaning up sediment from soil erosion. And in agriculture, many such external costs are not calculated at all.

Ecologists and economists alike are starting to realize the value of properly functioning natural systems. These systems provide "ecosystem services" that directly benefit humans as well as other species, at no cost to us. Recently, Robert Costanza and others developed rough estimates of what various ecosystem services would be worth if we had to spend money to develop artificial systems to produce the same services (Table 2). They estimate that the annual value of ecosystem services is $33 trillion, which is similar to the GNP of all nations on earth. Thus, even if we were able to replace the services that are being lost due to global growth, we could not afford to do so.

TABLE 2:

Estimating the Annual $ Value of Ecosystem Services

	Trillion $
Cropland	0.1
Grass / rangeland	0.9
Temperate / boreal forest	0.9
Tropical forest	3.8
Swamps / floodplains	3.2
Lakes/rivers	1.7
Estuaries	4.1
Tidal march/mangrove	1.6
Coral reef	0.4
Continental shelf	4.3
Open ocean	8.4
Total	33.3

(Costanza et al., 1997)

TABLE 3:

Energy Use in a Wheat-Fallow System – Alberta

% of Total Energy Input

	Soil Zone		
	Brown	Dark Brown	Black
N fertilizer	17	28	43
Machinery	60	48	45
Savings from legume N	12	19	22

(Campbell at al., 1990)

In light of fact that standard measures of economic success ignore a significant portion of reality, a few economists have proposed alternative measures of economic success that can incorporate the negative sides of economic growth. For example, Daly and Cobb (1989) developed the Index of Sustainable Economic Welfare (ISEW). This index factors in income distribution effects on social welfare, costs of air, water and noise pollution, costs of lost wetlands and farmlands, costs from urbanization, and charges for depletion of natural resources. When the GNP and ISEW are plotted side by side for the U.S., they have a similar slope until 1970, when the GNP keeps rising steadily while the ISEW levels off and eventually declines. This clearly implies that the overall prosperity of the US economy has not greatly improved the quality of life for most citizens. And indeed many Americans express this in surveys done over the past decades. Thus the choice of yardstick will have a great impact on whether we deem a particular system, agricultural or otherwise, to be headed in a more sustainable direction.

Organic farming systems can reduce the level of externalities relative to comparable conventional systems. Many organic farms increase soil organic matter, which helps reduce soil erosion and runoff and stores CO_2 from the atmosphere. The use of legumes in rotation to provide nitrogen reduces fossil energy use. However, mechanized organic farms still rely heavily on fossil fuels for production. The relative proportion of the total energy in machinery versus fertilizer is illustrated in a study from Alberta (Table 3). Substituting legume N for fertilizer N reduced the overall fossil energy use by 12-22%.

Energy for machinery (including manufacture and operation) accounts for 45-60% of the energy budget. Thus agro-ecosystem designs are needed that reduce the amount of machinery needed and/or that produce their own biofuels in order to further reduce fossil fuel reliance. Yield per unit of fossil energy input might be a useful indicator to begin using as a measure of agricultural sustainability.

One reason for the reliance on fossil energy in modern agriculture is the deviation from the ecosystem processes that drive more subsistence forms of agriculture. Obviously, the fossil energy inputs have enabled dramatic increases in yield per unit land area. However, it is possible to begin designing back in as many natural processes as possible to improve sustainability without major sacrifices in yield. Several aspects of prairie agriculture that are not "natural" are listed in Table 4. Each of these changes incurs an environmental and/or economic cost. Current research and farm innovation are beginning to address some of these, as in the case of no-till, replacing fallow with annual cropping, and work on perennial wheat and perennial polycultures.

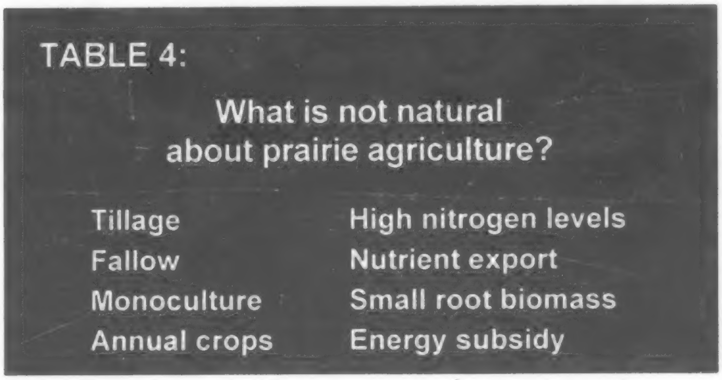


TABLE 4:

What is not natural
about prairie agriculture?

Tillage
Fallow
Monoculture
Annual crops

High nitrogen levels
Nutrient export
Small root biomass
Energy subsidy

The Long-Term Study at Pendleton, Oregon

One difficulty of assessing the "true" economics of prairie agriculture is the need for data over a long period of time. The high yearly variability of weather in semi-arid regions requires many years of study. Soil factors tend to change very slowly in dryland systems. A long-term study of wheat/fallow cropping systems at Pendleton, Oregon, provides a unique opportunity to examine sustainability in dryland farming.

The experiment, still underway, is a cooperative effort between the USDA Agricultural Research Service and Oregon State University, based at their joint facility in Pendleton. It was established in 1931 primarily in response to soil erosion issues of the time. Several different experiments were established, including the residue management study that will be referred to here. These experiments continue to the present, and in the early 1990s, researchers conducted a number of analyses to examine the trends over the past 60 years.

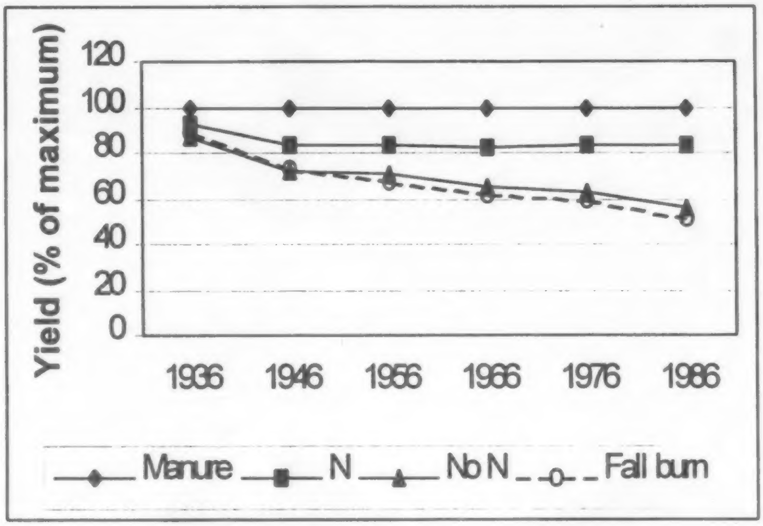
The wheat/fallow experiment used different residue management (straw retention, straw burning) and fertility (manure, pea vines, nitrogen (N) fertilizer, no fertilizer) treatments. All plots were managed with conventional tillage. The soil at the site is a Walla Walla silt loam with 0-4% slope. A full stature winter wheat variety was used until 1967, at which time semi-dwarf varieties were introduced. Average annual precipitation is about 15 inches/year, with most occurring between October and May.

Over the 60-year period, the manure treatment performed best in terms of relative yield and soil organic matter (Figure 1 and 2). The slope of the trend line for yield was slightly negative for all treatments for the period 1931-1966, indicating that soil degradation was reducing yield. Wheat yields jumped dramatically in 1967 with the introduction of semi-dwarf varieties, and trend lines had a positive slope from then on, with the exception of unfertilized plots with straw burning. Thus, a change in technology (wheat variety) was able to overcome the inherent productivity loss due to soil degradation (Duff et al., 1995).

Figure 1:

Management Effects on Wheat Yield in the Wheat / fallow Residue Experiment. Pendleton, Oregon. (Rasmussen et al., 1989)

Yield (% of maximum)



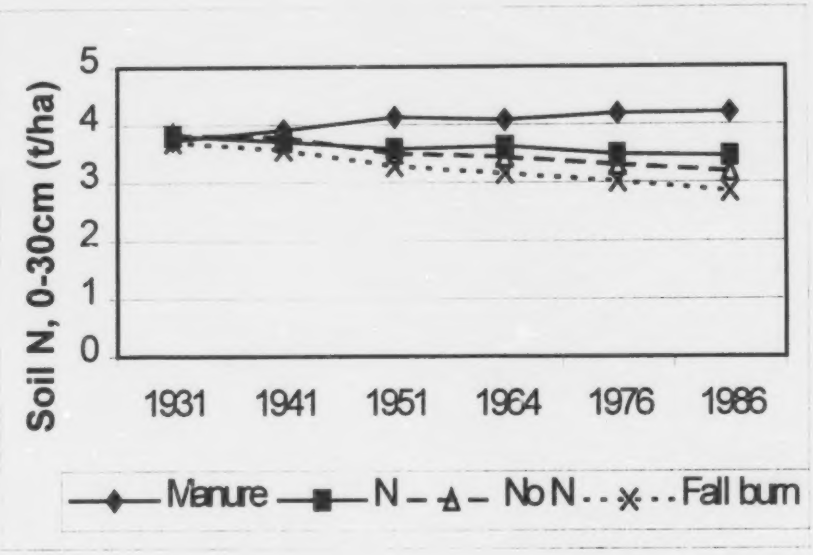
The researchers calculated the biological sustainability (BS) of the treatments over the period of the experiment. This was defined as the ability of the system to maintain or increase physical productivity (wheat yield at constant prices). It was sensitive to changes in technology and management, and to resource depletion. Biological sustainability declined with degradation in the soil resource base. High input systems maintained BS better than low-input systems. Varietal improvement improved BS through greater crop residues and water use efficiency. Yield improvement from new varieties, management, and fertilizer masked long-term impacts of erosion and soil organic matter loss on BS. At high rates, soil erosion can cancel the gains in BS from new technology. This last point was illustrated in a study by Walker and Young (1986) when they calculated the average long-term wheat yield with and without soil erosion for the eastern Palouse region. The effect of erosion acted similar to compound interest in that the yield reduction potential grew with time. Wheat yields climbed from 1930-1980 due to new technology. But by 1980, yields were some 10-15% below what they would have been without the historical soil erosion.

While all plots experienced loss of about half of the native soil organic matter from cultivation prior to the start of the experiment, only the manure treatment stabilized and slightly increased soil organic matter. Soil N, as reported in Fig. 2, is a proxy for soil carbon (C) or organic matter. Using the Revised Universal Soil Loss Equation, researchers calculated the average annual soil loss at 0.6 tons/ha/yr. The total loss of soil C over the course of the experiment was about 10.6

tons/ha. In order for erosion to reduce soil C by this amount, the erosion rate would have to be about 14.6 tons/ha/yr.

Thus, most of the soil C loss was due to oxidation and this produced a loss in soil quality equal to a soil erosion rate over 20 times greater than what was experienced. The loss of soil C is especially severe in wheat/fallow systems. Experience at Pendleton and many other locations has shown that a switch to annual cropping from wheat/fallow can bring about significant improvement in soil quality.

Figure 2:
Management Effects on Soil Nitrogen in the Wheat / fallow Residue Experiment. Pendleton, Oregon. (Rasmussen et al., 1989)



Researchers calculated the profitability and economic sustainability over the experimental period. Economic sustainability (ES) was defined as the ability of the system to maintain or increase total social profitability (a composite of biological changes and income/cost considerations, using indexed prices). Economic sustainability was sensitive to technology and management, resource depletion, production costs, commodity prices, and external costs (e.g. soil erosion). Economic sustainability was positive from 1930-1950, declining thereafter as production costs rose faster than wheat price and yield. Due to the negative trend lines, the researchers concluded that all current wheat / fallow systems are economically unsustainable, although some remain profitable. They believe that the declining ES trend lines imply that most systems will become unprofitable early in the 21st century. Government programs which increase ES may perpetuate systems which are biologically unsustainable. But government programs that enhance the soil resource can enhance biological sustainability (Duff et al., 1995).

The Pendleton study raises many questions about the long-term sustainability of dryland farming, even using fairly conventional economic analysis. The experiments were not adapted to include new developments such as no-till, which can have a positive impact on both profitability and soil quality. A recent comparison from Pullman, Washington, (Table 5) illustrates that no-till wheat can be a cost-competitive and resource-conserving practice (Camara et al., 1999).

TABLE 5:

Costs of No-Till Winter Wheat
Pullman, Washington

	Yield (bu/ac)	Variable Costs ($/ac)	Fixed Costs ($/ac)	Total Costs ($/bu)
Conventional	75	100	121	2.95
No-Till				
Ave.	86	114	115	2.66
Range	72-110	96-132	93-155	2.52-2.93

(Camara et al., 1999)

The Challenge of External Cost Accounting

The problem of dealing with external costs in agriculture is illustrated in calculations of the costs of soil erosion. While the absolute values differ among authors (Table 6), the on-site costs (those experienced by the grower) are consistently much less than the off-site costs (those born by society at large). Thus, growers have little incentive to address the problem while society often is anxious to solve it.

TABLE 6:

External Cost Estimates for Soil Erosion

	------ $/ton ------	
	On-site	Off-site
Ribaudo, 1989	0.24	3.05
Miller and Moore, 1987	1.27-3.04	2.81-5.34
Holland et al., 1997	1.50	5.00

Resource economists are developing estimates for many other external costs (Table 7). The air quality estimate was based on a Willingness to Pay value determined from a survey of households in the Spokane, Washington area impacted by smoke from grass seed field burning. Residents indicated they would be willing to pay the equivalent of $140 per acre per year to eliminate this burning. This amount of money, if transferred to farmers, would likely enable them to develop viable alternative practices. External cost estimates can also vary by region. The recreation and wildlife figures were developed for the Northern Plains region. When the same method was applied to more densely populated regions, the figures increased dramatically, indicating that farmland is of potentially high value to society for services other than food production.

There are still major gaps in efforts to estimate external costs from agriculture. For example, estimates have not been developed for groundwater impacts, fossil energy depletion, biodiversity loss, storm protection, or atmospheric impacts. Benbrook (1995) estimates the cost of pesticide regulation in the U.S. in 1995 at $1.2 billion, and projects that it will increase to $2.1 billion over 25 years. He states that this expenditure has done little to reduce overall risk. If this amount of money were invested in developing biocontrols and other ecologically-based pest management strategies, it would produce far more benefit for farmers and the public and require less regulatory cost in the future.

The advent of carbon sequestration credits and trading is beginning to assign monetary value to the avoidance of undesirable gas emissions from agriculture, and the value may be a significant source of revenue for farmers in the future. But some external impacts do not lend themselves to dollar valuation.

TABLE 7:

Other External Value Estimates

	$/ac/yr	
Air quality	140.00	*Holland et al., 1997*
Surface water quality	12.63	*Ribaudo et al., 1990*
Freshwater recreation	0.28	*ERS, 1999*
Pheasant hunting	3.00	*ERS, 1999*
Wildlife viewing	3.01	*ERS, 1999*

Definitions of sustainable agriculture include a social dimension, and little work has been done to evaluate social costs of agricultural production and policy. One example of assigning value is to look at the crime rate in urban versus rural areas. Criminal justice is the fastest growing cost to many state and local governments in the U.S., a cost borne by society at large. Our national policy, or lack thereof, over the past century has encouraged a massive shift of population from rural to urban areas. Using U.S. Dept. of Justice statistics, the crime rate in urban areas is nearly three times that in rural areas (Table 8). Overall crime rates have increased from 1967 to 1997, but the urban versus rural difference remains. Looking at population shifts during that period, the public potentially could have saved hundreds of millions of dollars per year through policy that helped people remain on farms and in rural areas, and thus prevented an escalation in criminal justice expenditures. An explicit policy of rural population retention has been adopted in Norway, for example, to avoid these kinds of costs (D. Young, pers. comm.).

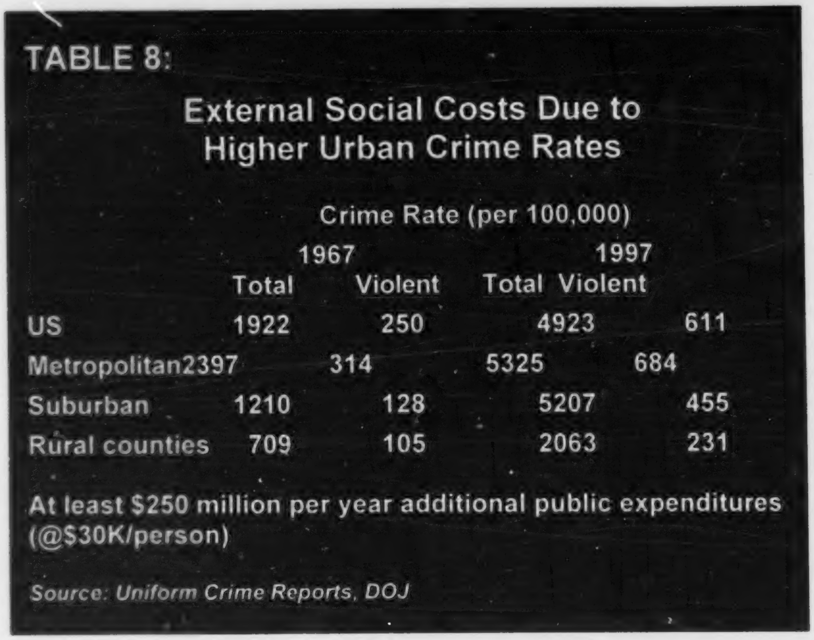


TABLE 8:

External Social Costs Due to Higher Urban Crime Rates

Crime Rate (per 100,000)

	1967		1997	
	Total	Violent	Total	Violent
US	1922	250	4923	611
Metropolitan	2397	314	5325	684
Suburban	1210	128	5207	455
Rural counties	709	105	2063	231

At least $250 million per year additional public expenditures (@$30K/person)

Source: Uniform Crime Reports, DOJ

Another way to look at the economic sustainability of dryland agriculture is to examine the various subsidies and costs borne by the public for that farming system, taking a cost:benefit approach. Estimates can be developed for public subsidies for research, extension, conservation, commodity support, and transport. In addition, estimates can be made for the external costs of wheat production that society bears (e.g. sediment removal). Using Washington State as an example, a very rough estimate would put the total publicly-borne costs at more than $100 million per year. Taking a simplistic view of benefits as the production of wheat on about 2 million acres (approx. 150 million bushels annually), the gross income amounts to some $450-550 million per year. Net income, however, ranges from -$50 million to +$100 million per year. Certainly, other benefits accrue from wheat farming, but a question worth considering is whether the current public expenditure could reap a greater public benefit in some other fashion in the same rural area. For example, if wheat farming systems could demonstrate a consistent amount of carbon sequestration in the soil, this could represent significant value in terms of carbon credits. Or development of farm-based biofuels could help produce renewable energy and give growers an alternative crop with elastic demand.

Next Steps

Organic farming and conventional production both need to be evaluated for their external impacts and costs to society when economic analyses are being done. The current simplistic evaluation of economic success, while necessary for sustainability, is inadequate in providing feedback to society about how well agriculture is achieving sustainability goals and serving the public good. This is not surprising, given that widely used indicators such as the Gross National Product have enormous sway in national economic policy. The development of new indicators such as the Index of Sustainable Economic Welfare is an attempt to address this problem, as is the increasing level of attention to quality of life and social issues on the sustainable agriculture agenda. While many organic farms are profitable and resource-conserving, social welfare aspects have not been seriously addressed.

David Granatstein
(photo by Darryl Amey)

Both organic and conventional systems in prairie agriculture could benefit from further development of conservation farming systems and innovations with perennial crops. No-till organic wheat is a researchable topic and would potentially lead to new ideas for weed control. Perennial wheat is being researched, and offers significant cost reductions, improved soil quality, and reduced machine and fossil fuel use. Farm-based biofuel from rapeseed has been developed at the University of Idaho. Researchers estimated that fuel from one acre of rapeseed could power the farming on about 10 acres of cropland. Combinations of these types of innovations are all amenable to research, and represent the types of research that public funds should give high priority, as there is little incentive for the private sector to pursue these topics. If equivalent public dollars were spent on these topics as are being spent on biotechnology, tremendous progress towards sustainability could be realized. These types of developments could increase farm profitability, enhance ecosystem services, and help bring together economics and ecology on the ground. ✪

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SPEAKER PROFILE

David Granatstein serves as the statewide coordinator for the Centre for Sustaining Agriculture and Natural Resources at Washington State University.

He has a diversity of experience working in cropping systems in the Northwest, Midwest, and overseas, including 7 years as an organic farmer.

His current interests focus on soil health, reuse of organic wastes, and incentives for environmental stewardship in agriculture. He is based in Wenatchee, Washington and works in the field of extension in sustainable agriculture.

David is well known as speaker in Canada and this is his second appearance at an organic conference in Saskatoon.

ECONOMICS

ORGANIC AGRICULTURE FACES THE SPECIALIZATION OF PRODUCTION SYSTEMS; SPECIALIZED SYSTEMS AND THE ECONOMICAL STAKES

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Prepared for presentation at an international conference, "Organic Agriculture Faces the Specialization of Production Systems," Sponsored by Jack Cartier Center, Lyon, France, December 6-9, 1999.

Introduction

Large, specialized food systems will quickly dominate global production and distribution of organic foods, if they are allowed free access to organic markets. During the early 1900s, essentially all food was produced without commercial fertilizers and pesticides, simply because they weren't available. Some farmers continued to produce by organic means, in defiance of the dominant trend toward reliance on inorganic fertilizers and pesticides, and became the leaders of the modern organic farming movement. But, organic production was of little interest or concern to the large, corporate food organizations until the recent rapid expansion in organic markets. Market expansion rates of 20-25 percent annually have been common during the 1990s, although rates vary among nations. At these rates, the organic market more than doubles in size every three years. Growing markets represent growing opportunities for future corporate profits. Expanding organic markets eventually will cut into profits from non-organic food markets. So the economic stakes for control of organic food production and marketing are large.

The current organic farming movement is as much a philosophy of life as a method of production. Organic farming methods are based on nature's principles of production – on farming in harmony with nature rather than trying to conquer nature. Diverse farming systems that integrated crops and livestock enterprises are designed to capture solar energy, recycle waste, and regenerate the soil. Organic farmers also believe in living in harmony with other people – in cooperating rather than competing. Healthy food, a healthy environment, caring communities, and a strong society are seen as the natural products of pursuing an organic philosophy.

However, recent trends are transforming organic foods into just another industrialized food system. Pressures to make organics conform to the dominant mass-distribution system for food is forcing organic producers to become larger and more specialized. Demands for consistency and uniformity of product quality and for dependability and timeliness of delivery are forcing producers to standardize, specialize, and centralize control of production and distribution processes. Such operations can reduce costs – but only if they are operated at a large scale. So large-scale, specialized organic production systems are emerging in the U.S. to meet the needs of a large-scale, mass distribution systems for food.

Mass production and distribution of organic foods is a fairly recent phenomena. Prior to 1990 most organic sales in the U.S. were direct transactions between farmers and consumers -- through local farmers' markets, community supported agriculture (CSA), pick-your-own operations, or farmers' roadside stands. Few organic retail food stores were in existence at that time, and they generally were small consumer cooperatives that purchased directly from local farmers or marketed local produce on consignment.

Over the past decade, the organic food market has changed dramatically. A New York based firm, Datamonitor, that monitors retail sales estimated that 60 percent of total organic food sales in 1997 was accounted for by specialty retailers such as Whole Foods and Wild Oats (Gilmore, 1998). Specialty retailers are not mainline supermarkets, but they are modern upscale chains of retail outlets that hold little resemblance to traditional organic consumer food cooperatives. Datamonitor estimated that sales of organic foods by conventional supermarkets grew in excess of 40 percent per year during the 1993-1997 period – doubling their share of the overall organic food and beverage market in the process. There is little doubt that specialty retailers and supermarkets now dominate total organic food sales in the U.S., although no uniform sales data for farmers markets, CSAs, restaurants, etc. are available for comparison.

Supermarkets and specialty chain retailers prefer to deal with suppliers that can provide a variety of high quality products, of consistent grade, uniformly packaged, delivered on a timely basis and at a competitive price. Most organic farms remain relatively small-scale and diversified, even as conventional agricultural producers have become larger and more specialize. But, few of the smaller organic farmers have been willing or able to meet the large retailers' standards. Thus, the bulk of mass retailers' purchases are made from a handful of large-scale commercial organic operations. Erick Kindberg, a U.S. expert on organics, estimates that a single organic consortium produces about 30 percent of all U.S. organic produce and 4 other growers supply an additional 40 percent. He estimates that the farmers typically classified as small growers provide only about 5 percent of total organic produce sold by the specialty chains and supermarkets. Anecdotal information indicates that U.S. organic retailers only buy sufficient quantities from local farmers to lend an element of credibility to their claims of selling locally grown foods.

A recent article by Chantal Le Noallec in Le Monde diplomatiuqe, indicates that many of the same trends are underway in Europe (1999). He states, "the organic sector is about to become industrialized, because agribusinesses are beginning to take a big interest in it. Farmland is increasingly being switched to organic, and the organic industry is developing based on mono-cropping. More seriously, a number of companies are pressing for present specifications to be relaxed, under the pretext of speeding up the conversion and making it possible to supply more products at even lower prices."

The oft-stated motives for industrializing the system is to make organic foods more accessible and acceptable to more consumers, to enhance the healthfulness, safety, and quality of food supplies, to expand markets for farmers, and to protect the environment from commercial fertilizers and pesticides. While these motives may seem logical, the consequences may be far different than initial expectations -- for consumers, for farmers, and for the environment.

The Economics of Specialized Systems

The motives for specialization of systems of production and distribution are largely economic in nature. Specialization is a fundamental characteristic of industrialization – the dominant model of economic development over the past two centuries. Adam Smith, the father of contemporary economics, expounded on the potential gains in productivity through division of labor. Division of labor, put simply, means that each laborer specializes in performing a single task, or a limited number of tasks, in the production process rather than attempting to perform the entire process. By performing fewer tasks, each laborer could perform their specific tasks much more efficiently. Thus, several specialized workers, by coordinating their work, could produce far more than could an equal number of workers working independently. At the beginning of the industrial era, in the late 1700s, Smith concluded that specialization, through division of labor, was one of the fundamental sources of differences in wealth among nations.

The same principle, specialization through division of labor, remains a cornerstone of industrialization today. A modern factory assembly line is nothing more than a means of coordinating specialized workers using specialized machines to perform a multitude of different tasks in producing a single product. Dividing the basic factors of production among different sources, with one group providing capital, another group providing labor, another management, and another supplying raw materials, is but another means of achieving economic efficiency through specialization. The same basic principles are applied in modern, specialized farming operations. Farms are designed to work as factories, with inputs and raw materials coming in and finished products going out, and with farmers performing a prescribed number of routine tasks in sequence to accomplish the transformation. Fields and feed lots are designed to operate as nearly as possible as biological assembly lines. Land, labor, capital, and management may each be supplied from different sources.

Specialization alone is not adequate to capture the full benefits of industrialization. Industrial systems also require standardization. Standardization is necessary so each function in the production process can be specified for purposes of dividing responsibilities -- the output of each stage of production must fit the raw material requirements of the next. When different organizations perform different functions, standardiation is required so a given producer can procure and utilize the same raw materials from a number of different sources. Food retailers who demand consistency and uniformity in the items they purchase for resale, are demanding standardization. A supermarket is but the last stage in a highly specialized food production system.

Industrialization also requires centralization of command and control. Specialization results in increased efficiency only if each stage in the production process is coordinated with the others. Coordination is achieved through centralization – one person telling other people what to do and when, where, and how to do it. If each specialized producer performs their assigned task, but does it independently, the process is not likely to be efficient. Centralized command and control allows each decision maker to control more resources, thus, industrialization is characterized by large-scale operations. Large organizations require large amounts of capital, thus, large publicly-owned corporations have evolved to meet the capital requirements of industrial organizations.

U.S. agriculture has followed the same general path toward industrialization as other industries. The process for agriculture has just proceeded more slowly. Agricultural processes, being fundamentally biological in nature, have been more difficult to standardize and control than were basic mechanical, chemical, and electronic processes. But over time, U.S. agriculture has become increasingly specialized, standardized, and centralized in nature — first through larger, independently owned farms but more recently through large-scale, corporate organizations.

The trend toward industrialization has been a trend away from organic agricultural production. Low cost, inorganic fertilizers and pesticides have been the primary technological facilitators of agricultural industrialization. Of course, mechanization also facilitated large-scale production. But, commercial fertilizers and pesticides allowed farmers to specialize without sacrificing basic productivity -- to break away from the diversified crop and livestock systems that were used previously to regenerate and recycle nutrients and to control pests. Standardized applications of commercial fertilizers gave farmers far greater control over the production process than had been possible before, and in turn gave farmers economic incentives to abandon organic farming methods.

The large agribusiness corporations became interested in control of agricultural production only after specialized, standardized farming systems were shown to be technically and economically feasible. These large corporations have sufficient capital to bring increasing shares of total agricultural output under increasingly centralized control. The new information and biological technologies promise even greater advantages for specialized, standardized, centrally controlled systems of agriculture production.

The system of production that initially chided organic farming as being obsolete now proposes to adopt it.

The Economics of Industrialization

Industrialization typically follows a fairly standard process from conception to completion – regardless of whether the process is applied to automobiles, public services, or foods. First, a potential mass market is identified – a sufficient number of customers who might be willing to buy enough of the same basic product to achieve economies of scale in production. Next, standards are established to define a specific end product that might be acceptable to the target market . Standards may be defined internally, through product development by a private firm, or through some public process, establishing grades and minimum requirements, for goods and services in the public realm. Standardized production processes are then put in place to facilitate mass production of the end product, and production is begun. If adequate capital is available, a vigorous advertising campaign may be mounted to help create market demand sufficient to ensure successful initiation of the new enterprise.

If the new enterprise is initially successful, specialized mass production will result in reduced production costs which in turn will allow the fledgling industrial operation to price its products at levels below those of its non-industrial competitors. Lower prices will allow the new firm to increase its market share, which will further reduce its costs of production and enhance its market advantage. The producer of the new product is now in a position to make major investments in non-price competitive strategies to further enhance its market share, increase its size of operation, and reduce costs. The objective is to establish the new industrial product as the "industry standard" with which all others will now be forced to compete, and ultimately, to which others must attempt to conform.

Invariably, the objective is to control an ever increasing share of the target market. Increased market share means greater economies of scale, and more important, more power to control total industry supplies and prices. Often times, the initiator of a new industry does not survive to reap the ultimate benefits of market control. But, the organization which initiated the process has the advantage of a head start on its competition, at the very least, and in many cases, will hold legal patents on processes that are critical to the production process. Some initiators have been unable to compete with new market entrants once the potential for industrialization becomes clear. Other initiators are bought out by competitors who have even more capital and market advantages than the initiator as result of their involvement in other industries.

The initial battles for market share can be brutal – cut-throat price competition may result in large losses for all competitors as the dominant firms compete for market control. By this time, most of the small, independent producers have already been forced out of business as other large corporations have decided to join the competition. However, the brutal competition typically does not last long. Once the number of surviving firms is reduced to a "manageable number," the individual competitors begin to search for legal means by which they can stabilize supplies and prices at levels that will be profitable for all. Beyond this point, competition for market share tends be "quiet competition," through advertising, public relations, etc., designed to compete without destabilizing overall profitability.

The Industrialization of Organics

This process of industrialization, with variations, has held true for industries in the U.S. as diverse as automobiles, mail order catalogues, supermarkets, discount retailing, public universities, electronic information processing, poultry production, and hog production. Based on these and other examples, there is logical reason to believe that organic food production is in the early stages of industrialization.

The rapid growth in organic markets in the U.S during the decade of the 1990s sent the signal to potential industrial suppliers that organic foods might be developed into a mass market. Prior to the 90s, organic foods were considered a niche market composed largely of those who were involved in, or at least sympathized with, the environmental counterculture movement of the 1960s. Rapid growth in organic markets during the 90s signaled that organic foods were gaining popularity among the general public, and that organic niche markets might be transformed into mass markets.

However, organic foods remained loosely defined, non-standardized products which were ill suited for mass merchandizing. No uniform definition or standards for organic products had been established – uniformity not being a requirement of niche markets. Several different states in the U.S. had established their own organic certification programs. And, different groups of organic farmers had established certification programs to facilitate trade among states and nations. But, the standards of certification organization were significantly different.

The United States Department of Agriculture (USDA) appointed a National Organic Standards Board (NOSB) in 1992, with representatives from various farmer groups and certification organizations, to assist the Secretary of Agriculture in developing national standards for materials to be used in organic production. In June 1994, the board made its recommendations to the Secretary. In February 1997, the USDA released a proposed set of rules that would have established national standards for organic products. After receiving more than a quarter-million public comments, the vast majority of which were negative, the rules were withdrawn for revision and future resubmission.

Most of the controversy surrounding proposed USDA standards centered on questions concerning use of municipal sewage sludge as organic fertilizer, eligibility of genetically modified organisms (GMOs), and use of ionized radiation for sterilization. Humane treatment of livestock and poultry also were controversial issues. Nearly all of the controversy seemed to stem from differences between agri-industry (food retailers, agribusiness firms, commodity organizations) and traditional organic farming organizations. Use of municipal sludge would have facilitated development of large-scale specialized organic production operations in urban fringe areas. GMOs were promoted as alternative organic means of pest control by the large biotech firms, such as Monsanto. Ionized radiation of foods presumable would extend shelf life and facilitate mass distribution through national supermarket chains. Livestock and poultry issues centered around permissibility of practices common in large-scale confinement feeding operations – livestock factories. There is little doubt that existing players in the industrial food system were seeking a set of organic standards that would allow industrialization of the production and distribution of organic foods.

A new set of proposed USDA rules for organics is to be released in the fall of 1999. The volume of negative comments from grass-roots organic farmers likely will force USDA to exclude sewage sludge, GMOs, and ionized radiation from the new proposed standards. There is less certainty that livestock and poultry produced in confinement will be deemed totally unacceptable. Canada is on much the same time table as the U.S. and introduced national standards for organic agriculture in the summer of 1999. The proposed Canadian standards exclude irradiation and GMOs. Presumably, differences between U.S. and Canadian organic standards would need to be resolved under the North American Free Trade Agreement (NAFTA). Regardless, the U.S. certification issue will not be resolved until sometime in 2000, at the earliest.

International standards for organic foods are evolving under the auspices of the United Nations by the Codex Alimentarius Commission - the body responsible for compiling standards, codes of practice, guidelines and recommendations to facilitate international trade. Codex apparently will set standards that will be enforced through the World Trade Organization under the General Agreement on Tariff and Trade. Multi-national agri-businesses, such as Monsanto and Novartis, may have even more influence in the international arena than in their respective home nations. European resistance reduces the likelihood that GMOs will be allowed under international standards, but other production practices needed for large-scale, industrial production are likely to find their way into international standards – if not immediately, almost certainly over time.

Government standards are promoted by economists as a means of reducing the cost of market transactions between buyers and sellers – thus improving market efficiency. This claim is valid. However, uniform grades and standards reduce transactions' costs far more for the large industrial producer than for the small niche marketer. Because of smaller volume of sales, and typically, geographic proximity, small niche marketers are better able to communicate directly with their customers, and thus, benefit less from being able to use the *market shorthand* of standardized grades. Government standards provide their greatest benefits to large-scale producers with large numbers of geographically dispersed customers supplied through multi-level marketing channels. Thus, establishment of government grades and standards helps create a competitive advantage for large-scale, industrial producers.

Organic production cannot become fully industrialized until there are uniform national and international standards that will accommodate large-scale, specialized, centrally controlled methods of production. Such standards could conceivably evolve in the private sector, as in the case of automobiles, computers, consumer electronics, and other industrial goods and services. But, government sanctioned standards make the process far easier. Once standards are in place, a combination of corporate advertising and government "information" can be focused on convincing consumers that the only true "organic" products are those which carry the appropriate government label.

Some private entrepreneurs have seen potential profitability in mass merchandizing organic foods, with or without organic standards. Owners of specialty organic food stores, Whole Foods and Wild Oats being the most notable, have expanded beyond their traditional niche marketing role to become mass merchandisers of organic foods. They expanded by building new retail facilities and buying existing organic and natural foods stores from others. Today, Whole Foods operates under at least five different names, in addition to its own, and Wild Oats operates markets under at least thirteen different store names. These organic chains are attempting to gain economic efficiencies through large-scale procurement and distribution by establishing their own standards for major suppliers. Whole Foods, Wild Oats, and the national supermarket chains now control nearly all significant mass market outlets for organic foods in the U.S.

With respect to the industrialization process, the organic chains and supermarkets have identified a potential mass market and have achieved some degree of standardization through private buying specifications negotiated with a relatively small number of large-scale suppliers. Significant market consolidation of the specialty chains has been achieved by Whole Food and Wild Oats. The next major step in industrialization may be initiated by the large supermarket chains. Supermarkets have been experimenting with organic merchandizing for some time. *Supermarket News* reports that national chains "Kroger and Safeway are doing the best job with organics, and some of the individual Shop and Stop stores are doing a phenomenal job." (1999, p. 40). If the major supermarkets decide they have a future in organics, the battle will be on for increasing market share.

The national supermarkets could be joined by food discount chains, such as Walmart, in initiating a round of cut-throat price competition -- which to date has not been seen in organic markets. Walmart is notorious for driving out competition by cutting prices. Supermarkets will not mount a major national advertising and promotion campaign for organic foods, until they have a strategy for ensuring that each dollar spent for organic doesn't mean a dollar less spent for non-organic foods in their stores. Thus, they will attempt first to gain market share from the specialty chains. They may force the specialty chains out of business through price cutting, or may buy them out if pricing them out becomes too expensive.

Under either scenario, price cutting at the retail level will force prices paid to organic producers to the lowest possible levels. Organic producers will be forced to specialize, standardize, and centralize their production systems in order to achieve economies of scale and reduce costs to levels necessary for survival. Many smaller, independent organic producers will be forced out of business by reoccurring production surpluses and chronically depressed prices. Organic consumers may benefit from lower prices, at least initially, but they will no longer have choices among products produced under alternative "organic-like" production methods. Standard organic methods will reflect the least cost means of meeting minimum government standards.

Ultimately, mass markets for organic foods will be controlled by a few large corporate retailers and will be supplied by a few large corporate producers. Supplies will be restricted in order to stabilize prices at levels high enough to yield acceptable returns to corporate investors. Only then will stability and profitability return to organic mass markets. Organics will have become industrialized.

An Alternative Road to the Future

At present, most organic farms are still small, and most organic farmers are still making their living through niche markets. They sell their products direct to their customers, through Community Supported Agriculture associations (CSAs), farmers' markets, roadside stands, etc., relying on their personal reputation rather than organic certification to ensure product integrity. As indicated previously, the specialty chains and supermarkets buy nearly all of their organic produce from a handful of large organic suppliers.

A 1998 survey conducted by the Organic Farming Research Foundation found that 87 percent of U.S. organic farms are single-family operations or family partnerships. More than 60 percent are full-time farming operations, but the average size of an organic farm is only about 140 acres. Only 14 percent of farmers responding to the survey reported annual total sales of more than US$100,000. Thus, organic farming in the U.S., at least in terms of farm numbers, is still dominated by small, family farms. In terms of annual sales, organic farms are not greatly different from U.S. farms in general. However, the proportion of full time organic farmers is far larger for organic farms, and organic farms are less than half as large in acreage as their conventional neighbors.

Small, diversified farms cannot compete economically in a fully industrialized agriculture. The number of farms in the U.S. has dropped dramatically over the past several decades and it's generally conceded that there will be few independent producers left producing basic agricultural commodities in the U.S. in another ten to twenty years. Corporate control of input and marketing sectors will force farmers to become contract growers within vertically integrated systems that control all aspects of the system from genetics to retailing. Until recently, organics had seemed to be among farmers' best alternatives to avoid either giving in to corporate control or getting out of farming. Now it appears that organic production may become industrialized almost as quickly as conventional farming.

However, small farmers do not have to become a part of the industrialized food system. Organic farmers, in particular, already have niche markets, which they can quite likely retain and expand, if they continue to capitalize on the value of their uniqueness. They can't compete by being the lowest cost producers, at least not in terms of dollars and cents, but they can compete in catering to the unique tastes and preferences of consumers.

Current preferences of many organic consumers are not based solely on the restricted list of materials that may be used in organic production. To them, organic is as much a philosophy of life as a physical characteristic of the foods they eat. They want products produced by nature's principles of production – produced in harmony with nature. They believe in diversity as a fundamental principle of nature. They will pay premium prices to support farmers with integrated crops and livestock enterprises that capture solar energy, recycle waste, and regenerate the soil to ensure food and farming opportunities for future generations. They believe in living in harmony with other people – in paying a price for food that will support farm families rather than simply buying whatever is cheapest or most convenient. Healthy food, a healthy natural environment, caring communities, and a strong society are important in their philosophy of life.

Organic farmers can join with other small farmers in developing an alternative food system that can coexist with, and someday displace, the global industrial food system. Independent organic farmers may not be able to compete in producing "certified organic" products and may well lose the battles to keep things such as municipal sewage, irradiated foods, confinement livestock, and even GMOs, from being certified organic. But, they can still compete for profitable, promising niche markets.

The single battle that they can least afford to lose is the one regarding organic food labeling. The initial USDA proposed rules asked for opinions regarding prohibitions of labeling of foods with names that might be confused with organic – such as low-input, antibiotic and hormone free, and sustainable. The intent of such restrictions might be to avoid confusion, but the impact would be to make "organic" the sole domain of industrial producers. If independent organic food producers are to survive and prosper, they must be able to produce, label, and market their products using ecologically sound methods that differ from the standards of industrial organics.

Sustainable agriculture offers the best hope for the future success of independent organic producers. The sustainable agriculture movement reflects a philosophy of life that is quite compatible with the current organic philosophy. In fact, one might logically argue that all sustainable system of agriculture production ultimately must be organic systems -- although all organic systems certainly are not sustainable.

In essence, a sustainable agriculture is one capable of meeting the needs of the present while leaving equal or better opportunities for the future.

Consequently, all sustainable systems must be ecologically sound, economically viable, and socially responsible. A system lacking in any one of the three simply is not sustainable. Organic production methods address the ecological dimension of sustainability. The challenge of economic viability must be met through efficient resource management and effectively marketing to customers who most value ecologically sound and socially responsible production. The final dimension, social responsibility, includes social justice and social equity. Social equity and justice are fundamentally incompatibility with industrialization. Sustainable organic producers will have their greatest economic advantage in marketing to the growing number of socially and ecologically conscious customers.

Sustainability relates to a goal or purpose – not to a specific set of farming methods or practices. Sustainable production methods are individualistic, site specific and dynamic. Sustainability for a given farmer, on a given farm, and at a given time may be different from those of another farmer, on another farm, or at a different point in time. Thus, sustainability cannot be standardized. Sustainable farming systems are inherently diverse because nature is diverse and sustainable farming must be carried out in harmony with nature. Thus, sustainability cannot be specialized. Finally, since sustainability cannot be standardized or specialized, it cannot be centrally controlled, and thus, cannot be industrialized.

Sustainable organic farmers must develop a non-industrial food system that is compatible with the principles of sustainability. This alternative system may continue to rely on direct marketing through current niche marketing methods, or may evolve into a flexible, decentralized, producer/agent/customer network. Regardless of how it evolves, it will not be an industrial system. Sustainable organics may require government protection, at least to allow truthful labeling of products with respect to diverse production methods. Sustainable farmers may also require protection from predatory pricing tactics of industrial food producers. At the very least sustainable organic producers should demand elimination of current government subsidies for industrialization. Without such actions, a global system of "industrialized organics" likely will emerge – dominated by multinational corporations, motivated solely by profits and growth.

Sustainable organic production will require more intensive management than is required of industrial production. Sustainable producers must put more of themselves into their operation if they expect to prosper with less land and less capital. But first, organic producers must approach the new challenge with a non-industrial mindset. They must realize that industrial organic production is no more sustainable than is chemically dependent conventional production. They must move beyond organic as a means of production to see organic as a philosophy for sustainable living. ✪

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SPEAKER PROFILE

John Ikerd was raised on a small dairy farm in southwest Missouri and educated at the University of Missouri with BS, MS, and PhD degrees in Agricultural Economics. He was employed for three years with Wilson Foods in Kansas City, MO, Atlanta, GA, and Detroit, M between BS and MS degree work. Dr. Ikerd worked in Extension Agricultural Economics positions at North Carolina State University (1970-76) and Oklahoma State University (1976-84) and was Head of Extension Agricultural Economics, University of Georgia (1984-89). In 1989 he returned to the University of Missouri under a cooperative agreement with the USDA, to provide state and national leadership for research and education programs related to sustainable agriculture. He retired and received appointment as Professor Emeritus of Agricultural Economics on February 1, 2000.

His work included National Sustainable Agriculture Projects with the USDA SARE Program, the development of Farm Decision Supports Systems for Sustainable Agriculture (PLANETOR), Sustainable Agriculture Education Council (SA Professional Development Program), Addressing the Quality of Life Dimension of Sustainable Agriculture, Regional Liaison-South and Northeast- SA Professional Development Program, and State Co-coordinator of SA Professional Development Program for Missouri.

Since retiring from the University in early 2000, Ikerd spends most of his time writing and speaking out on issues related to sustainable agriculture with an emphasis on the economics of sustainabilty. In addition, he continues as the project leader for a three-state, five-year program, with funds from the W.K. Kellogg Foundation, which links sustainable agriculture and sustainable rural community development. Dr. Ikerd plans to continue writing and speaking out on economic and sustainability issues into the foreseeable future.

SUSTAINABLE FARMING AND RURAL COMMUNITY DEVELOPMENT

— JOHN E. IKERD —

PROFESSOR EMERITUS OF AGRICULTURAL ECONOMICS
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"Every few hundred years in Western history there occurs a sharp transformation. Within a few short decades, society rearranges itself – its worldview; its basic values; its social and political structure; its arts; its key institutions. Fifty years later, there is a new world. We are currently living through just such a transformation."

—Peter Drucker,
Post-Capitalistic Society, p. 1

Rural Communities: Places Without a Purpose

The roots of most American rural communities are in agriculture. The land that is now the United States was a land of great natural wealth. Some of that wealth was in minerals and timber, but most of it lay in vast plains and winding valleys of fertile farmland. However, it took people to transform this wealth into wellbeing. People had to clear the land and till the soil to bring forth the bounty of food and fiber from the fertile fields. It took people to care for the cattle and sheep that grazed the vast plains. And as these people -- these farmers and ranchers -- achieved surpluses beyond their own needs, they came to need other people in towns and rural communities. They needed people with whom they could trade their surpluses for the things they couldn't produce. They needed blacksmiths, dry goods stores, livery stables, banks, and salons. But they also needed schools, churches, and medical care if they were to move beyond economic survival to achieve a desirable quality of life.

Some of the early American communities were built around timber and mining towns, but most towns were farming and ranching towns. And the more people needed to care for the land, the more people needed in town to support those farmers and ranchers. It's likely true that distances between many towns were determined by a day's round trip by horse and wagon. But, the number of people in those towns was determined in large part by the nature of agriculture. For example, lands well suited for vegetables and row crops could be farmed more intensively – supporting more families per acre or section. Lands suited only for small grains or pasture were farmed less intensively – supporting fewer families per section or township. Of course, town folks also had mouths to feed with locally grown foods – greens, milk, eggs, and bacon. But, the density of population in most rural places reflected the nature of their agriculture.

At the turn of the 20th century, America was still an agrarian country – about 40 percent of its people were farmers and well over half lived in very rural areas. But, then came the second phase of the industrial revolution and the need to collect large numbers of people into cities to "man" the large factories and offices of a growing manufacturing economy. The simultaneous industrialization of agriculture – mechanization, specialization, routinization, - made it possible for fewer farmers to feed more people better - "freeing" farmers and other rural people to find work in the cities.

The same technologies that pulled rural people toward the cities pushed them off the farms and out of rural communities. These technologies increased production per person by substituting capital and generic knowledge for labor and individual management. As successful new farming technologies were developed, they invariably reduced production costs -- per bushel or per pound of production -- but only if each farmer produced more. Thus, the incentive to realize greater profits by reducing costs was inherently an incentive to buy bigger equipment and more commercial inputs in order to farm more land and produce more output. As farmers individually responded to these incentives, production in total invariably expanded, market prices fell, and the promise of continuing profits vanished. The new technologies were now necessary – no longer for profits but now for survival. Those who adopted and expanded too little too late were unable to compete. They were "freed" from their farms to find a job in the city.

Farms were forced to get larger and larger just to survive. In fact, with a limited population to feed and a limited amount of land to farm, fewer and fewer farmers could possibly survive. In addition, large specialized farms often had to bypass the local community in purchasing inputs and marketing their products in order to remain competitive with other large farms. Their competitors were not down the road or across the country, but might be half way around the world.

Fewer farmers buying less locally meant less need for farm related businesses in small towns. Fewer farmers also meant fewer farm families to buy groceries, clothes, and haircuts in small towns. Fewer families also meant fewer people to fill the desks in rural schools, pews in rural churches, and the waiting rooms of rural doctors. Fewer people with a purpose for being in rural areas meant that many rural communities were losing their purpose as well.

Today, America is no longer an agrarian nation. Less that 2 percent of Americans call themselves farmers and even those earn more than half of their income off the farm. Somewhere around 25 percent of the people live in non-metropolitan areas – but many if not most commute to a city to work. There are few people left in farming communities to move to town and no longer any social benefit in moving them. Industries are "downsizing" and "outsourcing" -- laying off workers by the thousands. As consumers we spend on the average a little over a dime out of each dollar for food and the farmer only gets a penny of that dime. The rest goes to pay for commercial inputs and marketing services – packaging, advertising, transportation, etc. Society no longer has anything to gain from further industrialization of agriculture, but yet it continues. And rural communities in farming areas continue to wither and die.

Feeling the stress of an industrializing society, many small towns turned to industrial recruitment – trying to become a city rather than a town – as a means of survival. Others have tried to capture natural advantages in climate or landscapes to become destinations for tourists from the cities. Those near the growing industrial centers "rented out their communities" as bedrooms for those who are willing to commute to the city. But, most rural communities in agricultural areas have not been successful in their efforts to regain prosperity – or even to survive. Most rural communities have become and remain places in search of a purpose.

Farming: A Profession without a Future

As rural communities have lost their purpose, farming – at least farming, as it is known today – has lost its future. There is no future in farming – at least not in the kind of farming that requires ever-increasing amounts of capital and commercial inputs to produce basic commodities for processing into food and fiber for global markets. By definition, if the trend toward larger, more specialized production units continues there will be room for fewer and fewer of these units until only a handful remains.

As capital requirements continue to grow, a corporate share-holding organizational structure will be required to finance agricultural enterprises. Giant corporate entities already control the processing and distribution sectors for most agricultural commodities. As corporations gain control of agricultural production – through outright ownership or through contractual arrangements with individual producers -- those who refuse to contract will find they have no markets for their products. The surviving "farmers" will, in fact, become corporate "hired hands." Thus, there is no future in farming – as long as the only options farmers are given are to get big, give in, or get out.

One need only look to corporate structure of the poultry industry as a model for future livestock production. Corporate domination of cattle feeding has been a fact of life for years and the farm cattle feeder has become a rarity. Corporate control of hog production is becoming a reality – with recent attempts by large operators to gain market share forcing hog prices to their lowest levels since the Great Depression. Corporate contractual control of ranching operations is likely not far in the future.

Corporate control of fresh fruits and vegetable production has been around for decades, but may not be the model for the future of field crops. Genetic engineering instead is the key to corporate control of crop production. Genetically modified organisms (GMOs) can be patented – giving the patent holder exclusive rights to their utilization. The corporations who hold the patents on the seed stock will either control or contract with those who control processing and distribution of the resulting farm commodities. Thus, the only viable markets will be for commodities from organisms that have been genetically modified in some way – and are produced under contract for the patent holder. This same strategy will likely be employed by livestock operations as well – as corporate consolidation of firms in both the crop and livestock sectors continues.

The publicly stated justifications for the demise of farming will be to "ensure that the public continues to have an adequate supply of safe and healthful food at a reasonable price" – the same as the oft-stated justification for the industrialization of agriculture. However, the true motivation for the corporate takeover of agriculture is pure economic power. Those corporations that have been able to gain control of significant sectors of agriculture have been able to reap large profits in return. If a handful of corporations gain control of the global food supply – they will have more economic power than has ever been seen. It is a prize they are willing to pursue at any risk.

Can farmers compete head-to-head with the big corporations by forming cooperative organizations and networks? Perhaps, for a while, but the longer-term outlook for farmer collectives is doubtful at best. Will farmer groups grow big enough, fast enough to keep up with the consolidation of corporate power? This game is not just about economic efficiency, or minimizing costs of production, it is about raw market power. Will farmer groups be willing to rape the environment and gut rural communities -- if necessary -- to pursue their economic goals? If they are, is society any better served by a group of such farmers than by a group of similar minded businessmen?

Farming as we know it is coming to an end. There is no future for farming, and no future for most rural communities, unless we are willing to embrace a new and different kind of farming and a new and different vision for rural communities.

The Inevitability of Change

There might seem to be little hope for farming, or for many rural communities. But, current trends, toward industrialization and corporate domination, will not continue. Trends never continue, at least indefinitely. And these too will come to an end – maybe far sooner than might now seem reasonable.

A couple of scientists proposed a list of the top twenty "great ideas in science" in Science magazine, and invited scientists from around the world to comment (Pool, 1991). Among their top twenty were such well known ideas as the universal laws of motion, the first and second laws of thermodynamics, and the proposition that all life is based on the same genetic code. But, the top twenty included another proposition -- that "everything on the earth operates in cycles." A few scientists responding to the Science survey disagreed with the proposed theory of universal cycles. But most who responded left "everything operated in cycles" on their list of the top twenty great ideas in science (Culotta, 1991).

Based on this theory of universal cycles, any observed trend is, in fact, just a phase of a cycle. This theory of cycles implies that farms will not continue to get either larger or smaller, at least indefinitely, but instead will cycle between growing larger and smaller over time. History provides numerous examples where land became concentrated in the hands of a few only later to be dispersed and controlled by the many. For example, vast feudal land holdings once dominated much of Europe, only to be replaced by independent land ownership. In the U.S., large plantations grew to dominate the South – only to later be dispersed among many individual landholders. In what once was the Soviet Union, giant communal farms are now being divided into smaller individual plots. It seems ironic that many of the advisors sent to the former U.S.S.R to facilitate this process of dispersion are deeply involved in the consolidation of independent farms into large-scale corporate production units in the U.S.

There have been similar cycles in the collecting and scattering of people. Anthropological evidence indicate that people who have concentrated in large cities in centuries past, have later - for a variety of reasons – abandoned those cities and dispersed themselves across the countryside. There is reason to believe that migration from rural areas to U.S. cities during the twentieth-century was simply a phase of a similar cycle rather than an unending trend. Most large center-cities have been losing population for decades as people move to the suburbs in increasing numbers. The current trend is called "urban sprawl" -- people now abandoning the suburbs for a few acres in the country. Even further migration to more isolated rural areas might be a logical continuation of the dispersion phase of this cycle. The most relevant question for rural communities might be when, and for what reasons, will people abandon the cities and suburbs to resettle rural areas? They won't necessarily come back to the same places abandoned by people before.

Toward A Post-Industrial Economy

Alvin Toffler, in his book Powershift, points out that many forecasters make the mistake of simply projecting unrelated trends into the future, as if they would continue indefinitely. Such forecasts provide no insight regarding how the trends are interconnected or what forces are likely to reverse current trends and move them in opposite directions.

Toffler contends that the forces of industrialization have run their course and have already begun to reverse. He believes the Industrial models of economic progress are becoming increasingly obsolete, and the old notions of efficiency and productivity are no longer valid. The new "modern" model is to produce customized goods and services aimed at niche markets, to constantly innovate, to focus on value-added products, and specialized production. Innovations that tailor products to the wants and needs of specific customers are replacing cost cutting as a source of profits and growth.

He goes on to state that "the most important economic development of our lifetime has been the rise of a new system of creating wealth, based no longer on muscle but on the mind" (p. 9). He contends that "the conventional factors of production -- land, labor, raw materials, and capital - become less important as knowledge is substituted for them" (p. 238). "Because it reduces the need for raw material, labor, time, space, and capital, knowledge becomes the central resource of the advanced economy (p. 91).

Peter Drucker, a time-honored consultant to big business, talks of the "Post Business Society," in his book, The New Realities. He states "the biggest shift - bigger by far than the changes in politics, government or economics -- is the shift to the knowledge society. The social center of gravity has shifted to the knowledge worker. All developed countries are becoming post-business, knowledge societies" (p. 173).

Knowledge-based production embodies enormous complexity in simultaneous and dynamic linkages among a multitude of interrelated factors. Cognitive scientists have shown that humans can deal consciously with only a very small number of separate variables simultaneously. Yet humans can perform enormously complex tasks; such as driving a car in heavy traffic, playing a tennis match, or carrying on a conversation – tasks that baffle the most sophisticated computers. In fact, people are capable of performing such tasks routinely by using their well-developed subconscious minds.

The subconscious human mind appears to be virtually unlimited in its capacity to cope with complexity. The human mind is capable of assimilating hundreds of feedback relationships simultaneously as it integrates detail and dynamic complexities together (Senge, p. 367). In fact, the human mind may be the only mechanism capable of dealing effectively with the systems complexities embodied in the production concepts that will dominate economic development in the future.

Drucker points out also that there is an important, fundamental difference between knowledge work and industrial work. Industrial work is fundamentally a mechanical process whereas the basic principle of knowledge work is biological. He related this difference to determining the "right size" of organization required to perform a given task. "Greater performance in a mechanical system is obtained by scaling up. Greater power means greater output: bigger is better. But this does not hold for biological systems. Their size follows their function. It would surely be counterproductive for a cockroach to be big, and equally counterproductive for the elephant to be small. As biologists are fond of saying, 'The rat knows everything it needs to know to be a successful rat.' Whether the rat is more intelligent that the human being is a stupid question; in what it takes to be a successful rat, the rat is way ahead of any other animal, including human beings" (p. 259).

Differences in organizing principles may be critically important in determining the future size and organizational structure of economic enterprises and ultimately in determining their optimum geographic location. Other things being equal, the smallest effective size is best for enterprises based on information and knowledge work. "'Bigger' will be 'better' only if the task cannot be done otherwise" (Drucker, p. 260). Small enterprises can be located almost anywhere.

When there is no longer any economic justification for bigness, there will no longer be any economic justification for corporations. The only societal motivation for chartering corporations was to make it easier to raise the capital necessary to finance enterprises larger than could be financed by individuals or partnerships of investors. Corporations have been subsidized by various means, providing additional incentives for businesses to become larger, under the assumption that larger organizations would be more efficient, and would pass along their cost savings to consumers. There are serious questions concerning whether corporations today serve any positive public purpose – even in cases where large operations might be more cost efficient. In an era where "smaller is better," corporations will have lost even their original claim to special treatment. Corporations exist only at the consent of the people -- the public granted their original charters, and the public can revoke those charters. The practical question for the future is whether corporations have gained so much political power that they may continue to exist, and even be subsidized, long after they have lost any societal purpose for being. But once they have lost their purpose, the era of corporations eventually will come to an end – regardless of their political power at the present.

Robert Reich, former U.S. Secretary of Labor, addresses future trends in the global economy in his book, The Work of Nations. He identifies three emerging broad categories of work corresponding to emerging competitive positions within the global economy: routine production service, in-person service, and symbolic-analytic services (Reich, p. 174). He calls routine service workers the old foot soldiers of American capitalism in high-volume enterprises. They include low- and mid-level managers -- foremen, line managers, clerical supervisors, etc. -- in addition to traditional blue-collar workers. Production workers typically work for large industrial organizations. These workers live primarily by the sweat of their brow, or their ability to follow directions and carry out orders, rather than by using their minds.

In-person service, like production service, entails simple and repetitive tasks. The big difference is that these services must be provided person-to-person. They include people such as retail sales workers, waiters and waitresses, janitors, cashiers, child-care workers, hairdressers, flight attendants, and security guards. Like routine production work, most in-person service work is closely supervised and requires relatively little education. In-person service providers utilize a diversity of organizational structures, ranging from individual providers to large franchised organizations. Unlike routine production work, individual personality can be a big plus, or minus, for in-person service workers.

Symbolic-analysts are the "mind workers" in Reich's classification scheme. They include all the problem-solvers, problem-identifiers, and strategic-brokers. They include scientists, design engineers, public relations executives, investment bankers, doctors, lawyers, real estate developers, and consultants of all types. They also include writers and editors, musicians, production designers, teachers, and even university professors. He points out that symbolic analysts often work alone or in small teams, which are frequently connected only informally and flexibly with larger organizations. Like Toffler and Drucker, Reich believes that power and wealth of the future will be created by symbolic-analysis, by mind work, rather than by routine production or in-person service.

John Naisbitt and Patricia Aburdene in their book, Megatrends 2000, call the triumph of the individual the great unifying theme at the conclusion of this century. They talk about greater acceptance of individual responsibility as new technologies extend the power of individuals. Their "mind workers" are called individual entrepreneurs. They point out that small-time entrepreneurs have already seized multibillion-dollar markets from large, well-heeled businesses – successes of small "upstart" in microcomputers and microbreweries provide a couple of examples (p. 324).

They point out, that the industrial revolution built the great cities of Europe, America, and Japan. But today's cities are based on technologies of 100 years ago such as indoor plumbing, electric lighting, steel frame buildings, elevators, subways, and the telephone. Railroads and waterways made it easy and inexpensive to move raw materials and finished goods over long distances, but it was much more expensive then to move people even short distances.

But, the cities have already lost much of their purpose as places for people to live. Multi-lane freeways and extended mass transit systems have allowed people to retreat to the suburbs by making it easier for them to get to and from work. Naisbitt and Aburdene contend that "In many ways, if cities did not exist, it now would not be necessary to invent them" (p. 332). Drucker adds that the real-estate boom, and the associated new skyscrapers, in big cities in the seventies and eighties were not signs of health. They were instead the signals of the beginning of the end of the central city. "The city might become an information center rather than a center of work -- a place from which information (news, data, music) radiates. It might resemble the medieval cathedral where the peasants from the surrounding countryside congregated once or twice a year at the great feast days; in between it stood empty except for the learned clerics and its cathedral school" (Drucker, p. 259).

People are abandoning the cities for the suburbs for quality of life reasons: lower crime rates, quality housing at a lower cost, and recreational opportunities. Many people are now free to abandon the suburbs for rural area for quality of life reasons as well: more living space, a cleaner environment, prettier landscapes, and, perhaps most important, for a place to regain a sense of community, a sense of belonging.

Many knowledge workers, while working alone or in small groups, are choosing not to face the world alone but rather are seeking community -- the free association among people. Large business organizations, government bureaucracies, labor unions, and other collectives have provided hiding places for avoiders of responsibility. In a community there is no place to hide. Everyone knows who is contributing and who is not. In communities, individual differences are recognized and rewarded. Enlightened individuals may well choose to restore a sense of community -- all but destroyed by corporate industrialism. These people are not looking for a place to hide but rather for a place to be recognized - a place to belong.

Toward A Post-Industrial Agriculture

If the rest of society is moving toward a post-industrial economy, why are some sectors of the agricultural economy, specifically swine and dairy, continuing to experience rapid industrialization? In Joel Barker's book: Paradigms, he points out that new paradigms (including developmental models) tend to emerge while, in the minds of most people, the old paradigm is doing quite well.

Typically, "a new paradigm appears sooner than it is needed" and "sooner than it is wanted." Consequently the logical and rational response to a new paradigm by most people is rejection (Barker, p. 47). New paradigms emerge when it becomes apparent to some people, not necessarily many, that the old paradigm is incapable of solving some important problems of society. Paradigms may also create new problems, while providing poor solutions to the old ones, when they are applied in situations where they are not well suited.

American agriculture provides a prime example of both over application and misapplication of the industrial paradigm. The early gains of appropriate specialization in agriculture lifted people out of subsistence living and made the American industrial revolution possible. But, the potential societal benefits from agricultural industrialization were probably largely realized by the late 1960s. More recent "advances" in agricultural technologies may well have done more damage to the ecological and social resources of rural areas than any societal benefit they may have created from more "efficient" food production.

Industrialization of agriculture probably lagged behind the rest of the economy because its biological systems were the most difficult to industrialize. Agriculture, due to its biological nature, doesn't fit industrialization; it is being forced to conform. Consequently, the benefits are less, the problems are greater, it is being industrialized last, and it likely will remain industrialized for a shorter period of time.

A new post-industrial paradigm for American agriculture is already emerging to replace the industrial model of agriculture. The new paradigm is emerging under the conceptual umbrella of sustainable agriculture. A sustainable agriculture must meet the needs of the current generation while leaving equal or better opportunities for those of future generations. To achieve sustainability, farming systems must be ecologically sound, economically viable, and socially responsible. All are necessary and none alone or in pairs is sufficient. Sustainable agriculture cannot be defined as a set of farming practices or methods, but instead must be defined in terms of its purpose – sustaining people across generations through agriculture -- and the ecological, economic, and social principles that must be followed in achieving that purpose.

The sustainable agriculture paradigm has emerged to address the problems created by the industrial model, primarily pollution of the natural environment and degradation of the natural resource base. This new paradigm seems capable also of creating benefits that are inherently incompatible with the industrial model -- such as greater individual creativity, greater dignity of work, and more attention to issues of social equity. It is conceivable that industrial agricultural systems might be developed that appear to be both profitable and ecologically sound – at least in the short run. But, industrial systems inherently degrade the human resources – the people they employ – they simply cannot meet the sustainability test for social responsibility.

The sustainable agriculture paradigm is consistent with the visions of Toffler, Drucker, Reich and others of a post-industrial era of human progress. Sustainable agriculture is management intensive, rather than management extensive. Sustainable farms must be managed holistically as a living organism – with consideration given to multitudes of interdependencies and feed back loops among their interrelated parts or organs. Sustainable systems must be individualistic, site-specific, and dynamic. They must be capable of responding to the every changing capacities and abilities of both the farmer and the land. Thus, sustainable farming is inherently information, knowledge, and management intensive.

Complexity, interdependency, and simultaneous processes are fundamental elements of the sustainable model, which is clearly biological rather than mechanical in nature. For such systems, size and form must follow function. In biological systems, individual elements must conform to their ecological and social niche. Big, specialized farms will be sustainable only if their "niche" is equally large and homogeneous. Most conventional commercial farming operations have already outgrown their niches. That's the basic source of their ecological, social, and economic problems.

The sustainable agriculture paradigm in agriculture is at about the same stage of development as was agricultural industrialization in the days of steam-driven threshing machines and steel wheeled tractors. In other words, a few sustainable agriculture pioneers are out on the frontier of knowledge, but this new frontier of farming is still far from being settled. Much remains to be learned about this new paradigm and only time will reveal how it is to be implemented in sustaining a desirable quality of life for farmers and for society as a whole. Some current examples of its application include: organic production of vegetables, grains, and meats; low-input production for local, direct markets; community supported agriculture (CSAs); farmers' markets and other niche market for ecologically grown products; management intensive grazing of livestock and seasonal dairies; free range and pastured poultry; and organic cotton. The USDA is supporting a project to develop mini case studies of one thousand successful sustainable farmers. This project quite likely will illustrate a thousand different approaches to sustaining agriculture – as many as there are farmers who pursue it. But, the project will also illustrate a common dedication to the same basic purpose and to the fundamental principles of sustainability.

It will take knowledge, "mind work," not physical or economic muscle, for farmers of the future to find a niche where they carry out farming by means that are ecologically sound, economically viable, and socially responsible. Returning to Peter Drucker's Post-Capitalistic Society: "In the knowledge society into which we are moving, individuals are central. Knowledge is not impersonal, like money. Knowledge does not reside in a book, a databank, a software program; they contain only information. Knowledge is always embodied in a person, carried by a person; created, augmented, or improved by a person; applied by a person; taught by a person, and passed on by a person. The shift to the knowledge society therefore puts the person in the center" (p. 210). People are at the key to farming sustainably. People – not new technologies – are the key to the future of farming and of rural communities.

The Renaissance of Rural Communities

Community economic development strategies are already changing to reflect knowledge-based approaches to economic development. As large companies and branch plants leave rural areas and move overseas for cheaper labor, communities are beginning to concentrate on improving the quality of jobs remaining. Rural people – if not community leaders – are beginning to question the old strategies of industrial recruitment, industrial parks, and tax breaks for new industries. The new strategies for community self-development are in line with the business theories of Reich and others. These strategies invest in mind-workers by encouraging entrepreneurs within the community to build small businesses and strengthen the local economy. Local buyer-supplier projects are encouraged to plug the loss in dollars leaving the community by replacing imports with locally produced goods and services.

However, most communities still seem to be lacking a clear vision of a new fundamental purpose for their existence. They know they can no longer depend on agriculture as the primary engine of rural economic development. They realize that industry recruitment is destined to fail for most rural communities -- there simple won't be enough American based industries in the future to go around. They see promotion of small-scale projects; such as niche markets, bed and breakfasts, and local festivals; as piecemeal, stop-gap strategies with limited long run potential for developing their community.

Rural communities that have no development strategies of their own essentially forfeit the rights to develop their communities to others – others from outside the community. Those "others" already have their own vision of the future in mind for rural areas – as places to dump whatever they don't want in "their back yards" in urban areas. They see rural areas as open spaces where they can build prisons, garbage dumps, landfills, toxic waste incinerators, and large confinement animal feeding operations. They are looking for open spaces housed by a few desperate people who will accept almost anything that offers a minimum wage job or a chance to sell out and move to town.

Rural communities need positive development strategies of their own – strategies that will create economic opportunity without degrading either the land or the people. They need strategies for "sustainable" development. They need development that is linked to local resources, that maintains the productivity of those resources, and protects their physical and social environment. However, sustainable development must also provide an acceptable level of economic returns and otherwise enhance the quality of life of those who live and work in the community. Development strategies that rely solely, or even primarily, on local natural resources are unlikely to fulfill these latter requirements. However, the obstacle of limited local resources can be overcome by those who have a clear vision of the new realities of economic development and a firm commitment to make their community a part of the coming rural renaissance. Limited natural resources will be leveraged -- in much the same way as equity capital is leveraged in financing a business. As the local economy continues to grow, its natural resource "equity" will become a smaller proportion of its total economy, but no less important than is equity capital to a business in ensuring its survivability and sustainability.

Robert Reich stresses that the economy is no longer local, or even national in scope, but is truly global. Neither communities nor nations can depend on capturing the benefits of local capital, local industries, or even locally developed technologies in a global economy. Money, jobs, and technology can and will move freely to anywhere on the globe where they can be used to the greatest advantage. First, sustainable development must be linked to something that cannot easily be moved. And second, sustainable development strategies must give local workers and investors a logical reason for investing, working, and spending in the communities where they live. Communities cannot be sustained with out strong economic interdependencies among those within communities. But, people must have strong logical reasons for developing interdependent relationships.

Reich outlines two fundamental strategies for national economic development in a global economy. First, he advocates investment in infrastructure, including such things as roads, bridges, airports, and telecommunications access systems. Infrastructure has two important development dimensions. First, it facilitates productivity by making production processes easier and more efficient. Second, infrastructure is geographically fixed in the country where it is built. If producers want to use U.S. roads, bridges, airports and communications accesses, they have to use them where they are, in the country that built them. Fixed natural resources – such as agricultural land – can be used to achieve this same critical developmental impact without building anything. The challenge is to find ways to leverage the local land base to support more people better without degrading the resource – to develop a more sustainable agriculture.

Reich's second, and even more important, development strategy is to invest in people. People who work with their minds will be the fundamental source of productivity in a knowledge-based era of the twenty-first century. This makes the local natural base less limiting, but no less important, than in previous eras of development. If a nation is to be productive in the post-industrial economy, its people must be productive. Reich apparently depends heavily on national allegiance to keep productive people working in the nation that helped them develop their minds. If agriculture is to be a cornerstone for rural community development, it must be the type of agriculture that employs the talents of thinking, innovative, productive people – it must be a sustainable agriculture. These are the types of people who can leverage a limited resource base into a vibrant, sustainable community.

With one important added element, Reich's strategy for national economic development – investing in infrastructure and local people -- becomes a logical strategy for rural community development. However, rural communities cannot depend on an allegiance of rural residents to their communities to keep productive people in rural areas. People can and do move freely among communities within the U.S. During the rural renaissance, it will be critically important for communities to be able to attract new mind workers, if there are to be places where "home-grown" mind workers will want to stay. The primary attraction of rural communities for current and future mind workers will be the promise of a desirable quality of life.

Quality of life is a product of human relationships -- relationships among people and between people and their environment. Obviously, other things such as employment, income, personal safety, economic security, and access to health care are important aspects of quality of life. However, quality of life also includes peoples' subjective judgments regarding self-determination, freedom to participate, individual equity, freedom from discrimination, economic opportunity, ability to cope with change, social acceptance, and treatment according to accepted social principles of one's culture.

Communities that survive and prosper during the rural renaissance will be culturally diverse. Diversity will be an important source of creativity, innovation, and synergistic productivity, and will be an important aspect of quality of life in rural areas. In rural communities people will have an opportunity to know each other individually rather than simply accept the stereotypes of their cultural groups.

Successful rural communities will be made up of long-time rural residents, bright young people who choose to stay, returning rural residents, those born in urban areas of the U.S., and those born in other countries. They may also be Anglo American, Afro American, Asian, Mexican, and Canadian as well. Male and female, young and old, rich and poor, educated and less well educated, may be viewed as different, but they must be respected for their differences in the workplace and in the town halls of rural renaissance communities. Communities that fail to meet the challenges of the cultural renaissance will be unlikely to provide the quality of life necessary to participate in the economic renaissance as well.

Basic Strategies for Rural Revitalization

Successful rural revitalization strategies for the future will be unique to each community that succeeds. Standard operating procedures, best practices, and recipes for success were characteristics of the industrial era but not of the post-industrial era of knowledge-based development. However, the fundamental principles and concepts outlined above can provide some guidance for those who have the vision of a rural renaissance and the determination to participate in this historic process. The following are a few of the more obvious elements of a successful rural revitalization strategy.

- *Invest in people:* People are the basic source of productivity in a knowledge-based era of economic development. The "virtuous cycle" of education, increased innovation, increased investment, increased value, and higher wages offers an alternative to the vicious cycle of industrial recruitment, low wages, declining emphasis on education, declining communities, and resulting downward spiral (Reich, 1991). The common practice of preparing the "best and the brightest" to leave rural areas will have to be reversed to meet the cultural and economic needs. "Home-grown" mind workers have a sense of the quality of rural life that immigrants from urban areas will be seeking. Quality life-long education will be equally critical to prepare people to succeed in the new, dynamic era of economic development.

- *Invest in infrastructure:* Good roads and access to airports will be important. However, modern telecommunications systems will be the key element in making rural areas competitive with urban and suburban areas in an information driven, knowledge-based society. A national initiative to bring twenty-first century communications systems to rural communities may be more important to rural areas today than was the rural free mail delivery and rural electrification programs of times past. Invest in facilities that will bring people together. A good farmers' market may be more effective than a recreation facility in helping people within the community understand each other's way of life.

- *Invest in quality of life:* Help people make the most of local climate, landscapes and recreational opportunities. Land use planning and zoning can make and keep quality spaces in rural communities providing quality places for people to live. However, farming, residential, and recreation land uses can be compatible – and must be compatible – in a sustainable rural community. Make health care an investment in the future. Provide maternity wards and pediatricians not just cardiac units and nursing homes. Make personal security and safety a top priority. This, as much as any single factor, will enhance the perception of rural communities a quality place to live.

- *Make a commitment of understanding, accepting, and valuing diversity:* Quality of life is about relationships among people. Thinking, learning, behaving, and working alike was necessary for success in the industrial era of development. Thinking, learning, behaving, and working differently, but working in harmony, will be be the key to success in the knowledge-based era of development. Communities that fail to understand, accept, and value diversity among people are unlikely to succeed in a knowledge-based era of development.

- *Link development to local resources:* This is the key to making development sustainable in any given place. Natural resources such as land, minerals, landscapes, and climates must be utilized, at least initially, in the geographic locations where they exist. Agricultural land is still the most valuable geographically fixed resource for many rural communities. Large scale, industrial agriculture provides little local community support. Sustainable agriculture, on the other hand, is a knowledge-based system of farming that depends on the productivity of local people. Wendell Berry points out, "...if agriculture is to remain productive, it must preserve the land and the fertility and ecological health of the land; the land, that is, must be used well. A further requirement, therefore, is that if the land is to be used well, the people who use it must know it well, must be highly motivated to use it well, must know how to use it well, must have time to use it well, and must be able to afford to use it well" (p. 147). Agricultural mind-work can multiply the value to agricultural products before they leave rural areas and replace many agricultural inputs that are brought in from elsewhere. Investments that sustain local agriculture may well be the most important investment many rural communities can make to sustain their local economies.

- *Share the vision:* A community must share its vision of the future rural America, and what it is doing to shape its own future with others, if it is to share in the rural renaissance. There may be a great-untapped demand for what rural communities have, or can have, to offer. Productive people who desire a better quality of life may simply be locked into an old vision of rural communities as places of depression, decline, and decay.

The most important single step toward success may be for those in the community to develop a shared vision of hope -- for a better way of life and a brighter future of their community. The vision of each person in the community will be different from the vision of others in many respects and not all will be hopeful. However, the people of a community must search for and find some common positive elements among their different visions to provide the nucleus for a shared vision of hope. Otherwise, the group is not really a community, but rather a collection of people whohappen to live in the same general area. A community that has found its shared vision has made its first critical step toward self-revitalization. Hope then can begin to transform reality. To paraphrase Jesse Jackson, the articulate civil rights leader, "if they can conceive it, and believe it, they can achieve it." The future of rural America belongs to those who have the courage to seize it. ✪

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SPEAKER PROFILE

John Ikerd was raised on a small dairy farm in southwest Missouri and educated at the University of Missouri with BS, MS, and PhD degrees in Agricultural Economics. He was employed for three years with Wilson Foods in Kansas City, MO, Atlanta, GA, and Detroit, MI between BS and MS degree work. Dr. Ikerd worked in Extension Agricultural Economics positions at North Carolina State University (1970-76) and Oklahoma State University (1976-84) and was Head of Extension Agricultural Economics, University of Georgia (1984-89). In 1989 he returned to the University of Missouri under a cooperative agreement with the USDA, to provide state and national leadership for research and education programs related to sustainable agriculture. He retired and received appointment as Professor Emeritus of Agricultural Economics on February 1, 2000.

His work included National Sustainable Agriculture Projects with the USDA SARE Program, the development of Farm Decision Supports Systems for Sustainable Agriculture (PLANETOR), Sustainable Agriculture Education Council (SA Professional Development Program), Addressing the Quality of Life Dimension of Sustainable Agriculture, Regional Liaison-South and Northeast- SA Professional Development Program, and State Co-coordinator of SA Professional Development Program for Missouri.

Since retiring from the University in early 2000, Ikerd spends most of his time writing and speaking out on issues related to sustainable agriculture with an emphasis on the economics of sustainabilty. In addition, he continues as the project leader for a three-state, five-year program, with funds from the W.K. Kellogg Foundation, which links sustainable agriculture and sustainable rural community development. Dr. Ikerd plans to continue writing and speaking out on economic and sustainability issues into the foreseeable future.

ORGANIC AGRICULTURE AND SUSTAINABLE COMMUNITIES:

CREATING SUSTAINABLE RURAL COMMUNITIES AND AN OPTIMISTIC FUTURE FOR THE NEXT GENERATION

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When the Northern Great Plains were settled first by aboriginal people, it provided pasture for ruminants and a vast diversity of plants for gathering. They did not settle in a single place, but followed the buffalo across the plains, finding sheltered places to live in the winter, eating food they had produced and trading with other peoples from the north and the south. The first Europeans were also practiced transhumance -- following animals in order to trap them and sell their skins. The ranchers and farmers who came to the region were from the beginning also market oriented. Grain and ruminants were raised to supply the growing cities on the eastern and western coasts of Canada, with exports to Europe and the United States. Part of that production was aimed at providing cheap food for the new migrants -- basic calories provided by small grains to keep people fed and wages low. Commodity grains were critical in that system. But by mid-twenties overproduction of grains depressed prices and led the country into the Great Depression of the 1930s.

By the mid-twentieth century more calories were not enough to meet the food demands of urban areas. Food prices are in general "inelastic" -- no matter how cheap a particular item becomes, we will not eat more of it. That is particularly true of grains. Increased incomes after the Second World War changed food consumption patterns, which some economists call "increasing diet quality". More grain went to livestock, which was taken east or west or south to be fattened and slaughtered to fill the plates of a growing middle class and a more affluent working class, in Canada and abroad. Commodity meats produced on Great Plains farms and ranches allowed this to happen.

But by the end of twentieth century, the market for food has shifted again. More people seek more differentiated diets. The wide variety of ethnic groups that make up Canada has always demanded specialty products as ingredients to special national or regional dishes. Increasingly, that dietary diversity is increasingly valued by many other segments of the population. These foods that are composed of specific, identifiable ingredients combine specific qualities valued by particular end users, which includes genetics, how it was raised, how it is processed, and where it comes from, among others. And these choices are not just a passing fancy of maturing yuppies. National surveys have found that people are willing to pay more for meat that has been raised humanely or vegetables that have been raised in ways friendly to the environment when given a choice. The increasing markets for identity-preserved food, particularly certified organic, suggests the pace at which this shift to the third level of consumption is taking place.

Trends and Counter Trends

It is helpful to examine the challenges to farm households and communities in terms of different sectors of society and the changes that each are experiencing. Classical political philosophers, beginning at least with Plato, have found it helpful to divide society into the spheres of Market, State, and Civil Society. The Market involves those institutions involved with the economy at all levels and which seek profit in monetary terms. The State includes governmental bodies at a variety of levels that provides formal rules and sanctions, has the legal monopoly of the means of violence, and distributes public goods and services. Civil society involves formal and informal groups of citizens that neither govern nor seek profit, but serve other functions based on societal values and beliefs. Ideally, the three spheres are in balance, with civil society mediating between the market and the state. When civil society is totally repressed and the state maximized, as in dictatorships, all resources are depleted. And when the market dominates and the state chooses to make rules that favor only market values of capital accumulation, natural and human resources are depleted, often in an extremely unequal manner. The current situation in much of the world has a very large market sector, with the state often subsumed to it, and civil society providing a small voice of alternative values and desired future states.

Market Trends

Two key trends dominate the market: globalization and post-Fordist industrialization. Decentralization (devolution) and privatization are key trends in governments world wide. Polarization and engagement are key trends in civil society.

Globalization, as it is currently configured, is the result of 30 years of removing international barriers to the flow of two out of the three factors of production. The first 15 years, between 1973 and 1988, were spent removing the barriers to international capital flow. The next 15 years into the end of the century were spent lowering the barriers to the international flow of goods and services (Flora, 1990). Decreased barriers led to increased competition. Increased competition has meant lower profit margins, particularly for things like undifferentiated commodities, including but not limited to agricultural commodities. Only commodities such as oil, where OPEC has managed to at last control supply, have seen prices rise. Lower profit margins, in turn, have led to the consolidation of many firms throughout the economy. It has only recently hit agricultural input suppliers and distributors. So, in agriculture, as in other firms in most areas of commerce, a few international firms control the trade. The recent push toward consolidation, as seen in financial services, telecommunications, and automobiles, is also occurring in biotechnology, food processing, and distribution. This has been accompanied by a sense of insecurity on the part of many individuals and companies. Figure 1 represents a picture of the agro-chemical industry as of November, 1999. Of course, this is only a historical snapshot. It undoubtedly does not reflect the current reality of continuing moves toward consolidation.

Concomitant, but independent from globalization and its impacts, is post-Fordist industrialization. Fordist industrialization brought us standardization and the assembly line. You could get any color car you wanted, as long as it was black. High capital investment increased the productivity of labor, so that Henry Ford paid his workers $5 a day so that they could save to buy a Ford car. But as more identical products were produced by the industrial manufacturing system and access to capital and technology brought more producers into the market, prices for those standardized commodities dropped, and with them profit margins.

Post-Fordist industrialization is a response to the competition and lower profit margins. An important aspect of post-Fordist industrialization is producing a differentiated product, rather than an undifferentiated commodity. Moving from commodities to products requires something a cluster of characteristics.

Commodities are generally sold based on weight or volume and sometimes based on one other characteristic, such as protein content, percent butterfat, or grade for meat products. Generally, we know much more about product quality than we bring together to market. Commodities are pooled, as distributors use quality requirements as a ceiling rather than a floor.

Post-Fordist industrialization has moved from commodities to products. CAD (Computer Assisted Design) and CAM (Computer Assisted Manufacturing) technologies have made it possible to produce a limited number of very specific products.. The number of intermediaries between producer and end user reduced. More tightly coordinated value chains are in place. Aided by quantum advances in information technology, just in time delivery keeps inventory low and reduced the need for warehouses. Products are not produced until they are sold. There is increasing separation of management from ownership, a decreasing number of core firms, and an increasing number of out-sourcers. What contributes to firm success has changed radically over the years. The same is true for agriculture.

Post-Fordist industrialization is now decreasing the links in the value chain between producers and end-users, which then enables the product to more nearly meet the needs of the end-users, commanding a better market place advantage. Reducing the links in the value chain is viewed in many industries as providing for more complete information flow up and down the chain, enhancing product development. In agriculture, reducing links in the value chain has traditionally been viewed as reducing transaction costs of getting commodities to market, not a mechanism to improve the product.

Industrialization works best when there is a separation of management from ownership. This first occurred in industry with the publicly held companies and the stock exchange. Owners were very uninterested in what took place on the factory floor or what happened to the waste that was a by-product of production and very interested in the value of their stocks and the quarterly profits. Thus, management's job was to enhance stock value and quarterly earnings or risk loosing their jobs.

This is increasingly happening in agriculture, as fewer and fewer owners are operators. Corporations do not own most land. City-dwelling heirs of farmers and ex-farmers own land. They may be family corporations, but for many of the family corporate owners, their bond to the land increasingly is the "wheat check." If that is low, providing better ecological services or treating workers and neighbors justly are unlikely to convince them not to find a new manager or renter for the coming year.

Within industrialization there is a decreasing number of core firms and an increasing number of outsourcers. Thus, key link in the value chain becomes consolidated, and risk is pushed out to various outsourcers. This is illustrated in broiler production poultry, with contract poultry growing, and is emerging in some forms of hog production. The core firms choose not to use their capital to buy the capital equipment needed for production or to employ the workers and managers who grow animal protein. Instead, outsourcing (more sophisticated version of the putting out system, a way of producing before the industrial revolution), is now increasingly a part of an industrial economy.

State Trends

As the market centralizes, governments are decentralizing. More responsibility is going to the local level. Devolution, as this decentralization is called, is based on the principle of subsidiarity: a decision should be made at the lowest possible level. Presumably, the people on the ground know the "needs" of the local population and are in the best position to mobilize the resources to meet those needs. One of the goals is to help re-legitimize the state as a social actor, to increase citizen's trust in government.

However, if this principle is not accommodated by a strong policy of democratization, it often means that local elites regain power they may have lost when federal governments demanded that excluded people become part of the local processes, from attending schools to access to credit. We have seen this in farm programs in terms of who has been able to profit by them. Thus when democratization is not present, de-legitimization of the state is increased by decentralization, as the local powers are viewed by already excluded populations as neither just nor effective.

Even with high degrees of democracy at the local level, resources often do not accompany the shift of responsibility from federal to state and state to local. Unfunded mandate from national to province and province to locality increase. Federal and provincial governments are moving from decisions based on equity to decisions based on efficiency.

Privatization is the logical result of moving from basing decisions on equity efficiency. There is a strong belief in the United States that the private sector is more efficient than the public sector, despite some stunning counter examples, such as the failure of the savings and loans in the 1980s.

Across the world we see a movement away from government supported extension services. The government in the past often took the risk in introducing new technology. Extension agents gave away hybrid seed, now a private sector function, and they performed artificial insemination, which has also moved to private business. In terms of agriculture technology, extension is increasingly a wholesaler, working with dealers and custom operators, licensing them to apply a variety of technologies that they, in turn, can sell for a profit. This does increase the efficiency of extension, but not necessarily its legitimacy with the tax-paying public.

The move from government oversight to self-regulation is a product of the privatization trend. If there is still some government oversight, serving the public good at lower private cost can be achieved. We are moving from design standards, where one is told how to design something that will presumably give required results, to performance standards, which allows firm management to determine the best way to meet food safety or pollution reduction guidelines. The move from design to results standards has been extremely effective in the industrial sector, reducing industrial emissions much faster than anticipated. In agriculture, we still seem to spend a lot of time on Best Management Practices (BMPs), with little attention to monitoring environmental performance in terms of ecosystem health.

Civil Society Trends

In civil society, polarization, accompanied in some cases by social conflict, is partially due to the increasing diversity of income, ethnicity, and worldviews, coupled with a decreasing ability to deal with difference. As a result, single-issue political mobilization is high. At the local level, the "bums" are thrown out over a single issue, and the reformers are only interested in changing that single issue. They know little else about general governance and the increasing responsibilities that are falling on the local level.

In terms of engagement, we are observing an increasing willingness to be involved where one makes a difference. Thus, while membership in traditional organizations may be decreasing (Putnam, 1999), involvement in specific community activities, such as constructing a playground, is increasing dramatically. Engagement means the formation of flexible information and action networks as one set of individuals or associations get together to address one opportunity and re-forms with different configurations for another. Information sharing becomes an important part of this engagement, as cooperation links the civil society and the market.

Further, there is multiple community activism, with individuals often linked to the new information technology, being active on local, province, regional, national, and international stages, bringing those various communities of interest together in new ways.

Rural Communities

Farmers and farming communities are currently confronted with these changes, providing fundamental challenges. Increasingly, interconnections between global and local forces of production are driving change in many areas of food and agricultural systems. In order to meet the demands of the new economy, agriculture must move from producing commodities to products, from many intermediaries to integrated supply chains linking producer much more directly with the end user, from specialization to flexibility in response to constantly changing markets. And this must occur in a setting of increased environmental awareness and concern for quality of life.

Changes occurring in agriculture and rural communities since the turn of the century reflect broader changes in the business environment around the world. Increasingly corporations are "downsizing" and becoming leaner and more capable of adapting to market demands (Nevis et. al, 1996: Hamel and Prahalad, 1996; Porter, 1996; Mintzberg, 1996). It is no longer the case that towns can be centered around an industry and have confidence in its permanence (Grant, 1996). Differentiating markets require constant change in product mix, affording new economic opportunities. Non-farm based programs for poverty alleviation in rural areas have already demonstrated the enormous potential in using networking techniques to identify and produce for a number of constantly changing and developing markets (Holly,1993).

A system that supports the production of a reliable, high quality and diverse food supply in ways that are profitable and competitive requires not only innovative alternative management skills but new strategic relationships, on farm and off-farm (Coaldrake et al., 1995; Sonka et al., 1995; Lejeune and Cloutier,1996). The challenges on-farm relate to how well farmers are able to make choices amid a myriad of alternative options that will enable them to move new management systems in place that ensures continued economic vitality, maintains or enhances environmental integrity and meets their quality of life goals.

Because agriculture generally occurs in a rural landscape, changes in its structure cannot be realistically assessed in isolation from the rural communities that surround it. Kirschenmann (1996) asserts that local agriculture flourishes better where there is a vibrant local economy and people can hold each other accountable for local actions. Allen (1995) suggests that farmers do better when communities have vital economies. This suggests the importance of linking on-farm activities to what goes on in the local community. More entrepreneurial partnership opportunities between farm and community are likely to develop where there are strong social relationships between community and farm. The process we are designing and researching builds these relationships

Granovetter (1985) provides a useful perspective for understanding how most economic behavior is embedded in social relationships. Flora and Flora (1993) developed the concept of entrepreneurial social infrastructure to understand better why certain patterns of interaction and collectively approaching problems can contribute to a locality's ability to respond to challenges in a rapidly changing context. Analysis of data of a recent study assessing the level of economic development in rural America provided important evidence in support of this hypothesis (Flora et al., 1997).

Accounting for already available resources available resources or assets is an important aspect to analyzing system changes. When looking at managing major changes in a community or farming systems, it is important to draw on the resources that exist in the community. These fall into three categories, or paths, which communities could use specifically when looking at making marketing based shifts. These paths could be phrased in questions

1) How might the community recognize and capture the full development potential of all local institutions, organizations or companies?

2) How can communities capture local resources and expand the availability of vital capital and credit for community building purposes?

3) How can local development leaders maximize the creative uses of all the assets of the community?

4) How can community members evaluate economic, social, environmental impacts of alternative choices?

Community Capitals for Sustainable Agriculture

Focussing on local capitals allow communities of interest and of place to recognize opportunities nurtured or built through networking, instead of identifying weaknesses of the community or gaps that need to be filled. It allows a process for involving the numerous stakeholders in a given community. (Kreitzmann and McKnight, 1993).

Human Capital

Human capital includes education, skills, health, values, and leadership. Organic agriculture contributes to human health by reducing the presence of nutrients and pesticides in food and in the ecosystem. It also can contribute to a more diverse and healthier diet.

Human capital involves values, which intersect with organic agriculture in terms of choosing to practice it and to support it. Monitoring the impacts organic agriculture on human capital involves the increased use of the knowledge, skills, and abilities of the local people. It means identifying local capacities, enhancing local capacities, and recombining local capacities.

Social capital consists of mutual trust, reciprocity, groups, collective identity, a sense of a shared future, and a working together. As we monitor this capital, we would expect to see strengthened relationships and communication, increased interactions among unlike groups within the community, increased interactions among unlike groups outside of the community, and increased availability of information and knowledge. Organic agriculture is forming a wide variety of new networks among market actors and civil society. These can in turn decrease transaction costs of production and distribution.

Natural capital is argued to be one of the major investments of organic agriculture. But we still need to monitor what happens to air quality, water quantity and quality, soil quality, biodiversity, and the landscape. Are these characteristics, of great interest to end-users, be part of organic agriculture development and implementation? Thus, we look for sustainable healthy ecosystems with multiple community benefits, human communities that plan and act in concert with natural systems, ecosystems that are used for multiple community benefits and one where those with alternative uses of the ecosystem seek common ground.

Communities of interest and of place must engage in discussions and reasoned debates in rural and urban communities concerning the implications of different approaches to agriculture research and implementation. We need to bring different people together to decide what is important to monitor in terms of agriculture innovation, so that we can be sure that no damage will be done and see the public benefits that accrue.

Financial and built capital includes capital, investment capital, tax revenue, savings, tax abatement, and grants – all involved in the development and implementation of organic agriculture. Does the public feel they are getting their money's worth from public sector investment in agricultural research? Is the public money's worth equal to an increase in value in biotechnology stock? Is it in the public good to strengthen rural communities, more regional food systems, and farm households? Does the public investment result in built capital that improves life and does not damage the environment? Does it result in appropriately diverse and healthy economies to reduce poverty, increase business efficiency, increase business diversity, and increase community resident assets?

Concern about impacts on multiple community capitals underlines the importance of monitoring multiple impacts. Monitoring, conducted by a wide range of groups from the market, the state, and civil society, and sharing results allows for quick response to unanticipated consequences; thus, the need to monitor all the forms of capital. It involves multiple stakeholders and the negotiations that lead to determination of indicators. This also helps to determine the perimeters under which biotechnology innovation occurs. It provides feedback to scientists. It provides feedback to the market. It provides feedback to citizens groups.

Privileging any form of capital over another can defeat all forms of capital in the long run. The current adoption of biotechnology, using the producer, short-term goals of pest protection will have many long-term negative consequences, including losing a powerful biological control and further decimating biological diversity, particularly among a variety of insects and other invertebrates.

Risky Shifts

Farmers and communities constantly make decisions. Most of the decisions, however, involve relatively minor change: how much N to put on a field, when to plant, when to repair a street or building. Those decisions allow the systems involved to continue functioning in the same way, only hopefully more efficiently. Risky shifts mean leaving the comfort zone, not returning to it.

Knowledge about alternatives that yield more desirable results alone does not lead to changed behavior, particularly in complicated behavior such as changing a farming system (Sapp et al., 1994; Moscovici, 1985). When decisions result in polarization or involve risky shifts, as in a shift from commodity production to more flexible, diverse systems, groups – social capital – are critical to that process. People change behavior because "we" do things that way.

Making Risky Shifts: First Understand What You Actually Do Now

Assessing outcomes requires that standard work be defined and measured. Standard work is different from routine work. No farmer claims her work is routine – weather alone makes for constant variation. Yet there are standard ways of responding to constantly fluctuating temperature, wind, and moisture than can be understood when considering alternatives. Changes that lead to new systems then becomes easier to monitor and assess over time. Our models will build on the highly successful Kaizen management strategy to develop a process-oriented, participative tool for changing standard work into a more sustainable system. The Kaizen or "constant improvement" has its roots in the Japanese business management culture and is recognized internationally as the substrate underlying the entrepreneurial success its managers have enjoyed since WWII (Holpp, 1989).

Managers who have extensively worked with this tool observe that several important elements intrinsic to kaizen underlie its success in improving product quality and firm profitability. Built into its framework is a process decision strategy which (a) anticipates possible outcomes and prepares counter measures that leads to the best possible solution (b) determines which processes to use to obtain desired results by evaluating progress of events and the variety of conceivable outcomes (c) forecasts and responds in advance to major events that may be predicted in a system (Mizuno, 1988). Its core values include total quality improvement in outcomes and process through the full participation of all stakeholders in the decision making process. Because dialogue is facilitated between stakeholders, negotiating process becomes an important outcome also. Our model takes kaizen principles, derived within a closed systems framework, into a nested systems setting.

Farm and community entrepreneurial linkages involve multi-stakeholder interactions with different goal and value orientations. The innovative decision support tool that we will use infuses the key kaizen elements of participation, dialogue and feedback that facilitate a continuous process negotiation and overall systems improvement.

Environmental qualities are the result of site-specific interactions among living organisms and their abiotic environments. These interactions may provide benefits to human communities in the forms of regulation and purification of water, aesthetically pleasing landscapes, and recreational possibilities. The bio-physical environment may also impose costs on human communities by harboring pests of crops, humans and livestock. Farming systems directly change local environmental systems in the areas where they are implemented by manipulating soil and managing biota. Farming practices can also impact distant environments by introducing chemicals and sediment into watercourses, and by removing habitat for migratory species. Evaluating the impact of agricultural systems on environmental qualities is, therefore, a multi-dimensional and multi-scalar problem.

Although there is much promise in community-based approaches for addressing rural development and natural resource management, there are significant problems to overcome as well. Communities may have a short-term focus, and single-problem orientation that restrict the range of alternatives or linkages that are considered in planning. Furthermore, communities may not recognize the value of natural capital upon which they depend, and they may not recognize or care about environmental problems that they export to other communities (Rhoads and Herricks, 1996). Thus, there is a need to foster awareness of local environmental conditions, and to promote continuous learning about changes in environmental conditions and ecological processes.

Extra-local industries and global corporations can improve economies in communities where they operate. But they also can usurp local raw materials, disrupt local ecologies and social organization patterns, undermining community quality of life.

At the same time that farms producing commodities using Fordist production methods are growing, in the U.S., Europe, and elsewhere, organic and alternative producers are bringing in new farmers with new ways of relating to the environment, to the customers, and to each other.

The Organic Farming Research Foundation, based in Santa Cruz, California, found that demand exceeded supply for the organic products they produced, encouraging 77% of the 1,200 farmers surveyed to increase their organic acreage and the number of crops they grow organically.

An Example of Farm-Community Entrepreneurial Partnerships and Risky Shifts

Tracy and Allen Williams, farmers in central Illinois, raised typical Midwestern crops in typical Midwestern style. They had moved to no-till corn on much of their land. They purchased their inputs from a local supplier and a specialized pesticide consultant. Tracy and Allen, plus their neighbors Chalk Taylor and Rick Alan provided labor for soil testing, nutrient application, spraying herbicide in the spring, planting the corn, harvesting the corn, and planting the cover crop. They marketed their corn to two local elevators, one that forward contracted to provide specialized corn to a Chicago tortilla factory, and to the Bennent Farm Cooperative Elevator, which sold to Archer Daniel Midlands in Decatur. The chemicals and nutrients from the land flow into the Sagamon River to Lake Decatur, the municipal water supply whose quality is threatened by high levels of pesticides and nutrients. That water then flows to the Mississippi River and the Gulf of Mexico, contributing to the hypoxia there. That linkage concerned Tracy and Allen, who are concerned about ecological health, social equity, as well as economic vitality of their household.

Allen, a popcorn lover, discovered an heirloom variety of exceptional eating qualities. He located a supplier in Ames, Iowa. And, to further differentiate the product (and to feel comfortable with Tracy eating it during her pregnancy), they decided to produce it organically. Instead spraying herbicides, they must till, rotary hoe, and cultivate to control weeds. This requires additional labor from their no-till labor force and additional fuel. Further, when the corn is higher, they must hand-weed, which they do not do with their no-till corn. This is a new labor need that makes organic popcorn a "risky shift". Now they use both migrant workers and high school students for hand-weeding. Labor is needed at a particular time of year that does this intense job. One source of labor is a reserve labor force because it comes from outside the community and is occupied elsewhere during other times of the year. The other is a reserve labor force within the community, where their basic occupation is student. A community side effect is that this also involves students with farming. However, hand weeding has some potential community level problems, particularly with migrant workers. They need housing and other infrastructures while they are there.

The corn is harvested by machine on both fields, and in both cases they store it on-farm. While all the no-till corn is further treated on the farm, some of the organic popcorn is processed on the farm to be sold directly to a growing network of folks who have heard about the great popcorn. As Tracy and Allen added childcare to their daily duties, it was easy to let the packaging go.

Doing the comparative field-based analyses, we discussed ways of breaking that bottleneck. One of them would be to keep the migrant workers in the community longer by engaging them as popcorn packers when they are not harvesting. Another way to ensure packaging would be to work with the local school system and 4-H to set up a youth entrepreneurship program. The youth could take over the packaging, managing the direct sales (particularly through the internet as well as a school-based stand), and get a cut of the profits in addition to the hand weeding they were currently doing.

Another option for packaging would be to spin off a separate business within the community, which would be in charge of the packaging and marketing aspects of it. That business would be loosely networked with the farm, yet stay within the community. What then gets moved outside the community is not high volume, low value corn, which is the case out of the grain elevator, but is low volume, high value that would not go nearly as far. On-farm sales could still occur which brings people back to agriculture.

Another possibility might be for development of machinery that can aid in hand weeding, which could evolve into another local small enterprise. The notion of sustainable agriculture is not anti-technology when we see technology based on appropriateness to environmental context and the human context.

New institutions built on new relationships have to be in place to handle these new arrows. These new entrepreneurial partnerships could be made with high school students, migrant workers, or local business people. Some old institutions get left out: the pesticide distributor, the nitrogen and nitrogen application from Platt County Farm Services Cooperative, Bement Grain Cooperative and ADM. Some of these institutions will be permanently eliminated, while others may change.

With the organic popcorn field, they still service their farm machinery from local dealers. They still have on-farm storage and maintenance of machinery, they still use fuel that they buy from their local Pratt County Farm Services dealer, which is their Farm Bureau Coop, where they would have bought their pesticides and their fertilizers. So the institutional change with the Pratt Company Farm Services is they would lose the input sales but they would continue to sell fuel. Pratt County Farm Services Cooperative is not necessarily going out of business, but adjusting what they do to the new system. Pratt County Farm Services Cooperative might be interested in helping to organize the farm labor. As a responsive, producer-owned input supplier, the Coop would not be put out of business but it would shift what it does in response to the changing conditions.

The comparative resource flow diagrams stimulate the farmer and other people in the community. The diagrams are not maps, but are schematics of the process. Thus everyone can begin to see what a different form of production requires both on the farm and in the community. A lot of work on sustainable agriculture is focused on a variety of on-farm techniques. Researchers have assumed that if by aggregating costs, time used and profits, the impact on the community can be determined. This approach is qualitatively different, because we are looking at the institutions that have to change to put it into place. The only way we could do that is compare our "standard" work to the innovation.

Changes are less likely to be made when too many changes must be made at once, particularly when the institutional structure is not in place to support those changes. Shifts become less risky if we are aware of the institutions that have to change with them. A model like this can help the provider of the traditional inputs to rethink their role. This model could help input providers move into biological pest controls more quickly and also into more farm management/consultant services. The Pratt County Farm Service Coop could change from being pass-through retail institution that adds wealth to the community only on their retail markup, to become a service firm that provides more services locally to return more of the dollars spent by the farmer to the community.

Where is the Canadian Center for Alternative Agriculture in this model? It can provide the transaction costs for the risky innovator. It can originate activities that then move toward the private sector. A role of the Canadian Center for Alternative Agriculture would be to facilitate the linkages between the new production options, and informing the private sector of these new opportunities, building connections, and help educate farmers and communities about alternatives and how to put them together.

Cornelia Butler Flora
(photo by Darryl Amey)

Focus on Relationships

Skills needed for success in agriculture are changing rapidly. As in other parts of the economy, globalization and industrialization make agriculture a more complex enterprise. And, as in other industries, concern for environmental as well as economic outputs and outcomes increases the complexity even more.

Production Skills

Success in agriculture has been based on production skills for at least 10,000 years. Producers knew their crops and animals and understood seasonal cycles and the need to adapt to climate and pest unpredictability. Knowledge was learned parent to child and neighbor to neighbor. That knowledge tended to be what Kloppenberg (1991) calls "mutable immobiles", knowledge specific to place that had to be modified when producers moved to a new area. Much of the early farm failures during the colonization and frontier periods in the U.S. and Canada came from using agricultural practices that were well-adapted to soils, climate, and array of pests in the home country to the very different conditions of the frontier.

Mechanical and Technical Skills

Major changes in the skills needed to be successful occurred with mechanization. Now farmers needed to know how to run and repair machinery. These skills were also learned from parent to child (generally father to son), but also in the formal educational system through vocational education. The knowledge involved in working with machines is primarily "immutable mobiles" – knowledge that does not depend on context. A spark plug's relation to the distributor was similar no matter who made the engine. Although in the U.S. farms got cars before they got tractors, work on any internal combustion engine prepared an individual to work on farm equipment and appreciate preventative maintenance. International development attempts to introduce machinery without the farm-based maintenance skills which characterized North American farms in the 1940s through the 1970s were often dismal failures. While dealer and independent farm repair garages were an important part of each rural community, they generally only dealt with major problems. Part of the winter for most farm men was spent maintaining machinery. Those that did not like machines or had no aptitude for them found it much more difficult to make a living in farming. Since machinery allowed more land to be farmed by an individual or household, farm consolidation favored the mechanically minded. Those leaving farming tended to be older farmers not raised in a mechanical tradition.

While the end of the First World War brought mechanical skills to agriculture, the end of the Second World War brought technical skills, particularly related to the use of fertilizers and pesticides. As it became more possible to farm more and more land in the same crop the need increased to add soil amendments and to apply pesticides, required by increased pest concentrations accompanying monoculture. It was important to know enough science to talk to dealers, if not to apply it safely oneself.

These two related additional skills acquired by farmers resulted in Fordist agriculture. Fordist agricultural production prevailed in the basic commodities supported by the federal farm programs. By mastering mechanical and technical skills, farmers were able to greatly increase their output. But, over time, they received a smaller and smaller percentage of the surplus generated. They did not control the value chain, and their undifferentiated product required protected markets and subsidies to survive the vicissitudes of increasingly global markets. Grain is an illustrative example of Fordist agriculture. Volume was the single price signal. Thus all efforts were on increasing production, which mechanical and technical skills – and government support programs -- greatly enhanced. Grain was sold at a local elevator, then went through numerous hands before reaching an unknown end user. As Smith (1993) documents graphically, over time farmers received an ever-smaller proportion of the food and fiber dollar, with more going to the inputs and more going to the processors.

Financial Management Skills

In the farm crisis of the 1980s, a different set of skills became critical for agricultural success – financial management. Knowing how much each enterprise cost and rendered, when to buy and sell, how to hedge and forward contract allowed some farmers to get control of a little more of the value chain. Knowing tax laws became as important as knowing the farm programs. The temperament it took to carefully work over a computer spread sheet at times was diametrically opposed to temperaments that took joy in new-born animals or a freshly plowed field. Many mid-career farmers left farming as financial management – and the time one had bought land – made it impossible to farm profitably.

The increasing layers of skills necessary for successful farming has resulted, on the one hand, in exits from farming. It has also resulted in an increased division of labor within agriculture. A different individual may provide each set of skills. And each set of skills retains a different proportion of the value it adds.

Relational Skills

Under the current situation of rapid globalization and industrialization, it is much more difficult for farmers to maintain a constant share of the value chain. These chains tend to be driven by relationships – with input suppliers, particularly suppliers of knowledge; with markets, particularly in reaching emerging markets; and with fellow producers in new models of "cooperatition". Relational skills reduce the transaction costs in carrying out the increasing number of tasks critical to farm success. New generation cooperatives, flexible marketing networks, development and marketing of specialty products all demand a broad networks. Granoveter (1985) refers to the market benefits from these as the "strength of weak ties". These networks are an important part of social capital. Rural areas, and farmers in particular, are often embedded in strong ties with relatively limited networks. The challenge for rural development will be to increase those ties in ways that rural communities and their citizens can retain a larger portion of food and fiber value chains.

Conclusions

While commodity production has always been disadvantaged in an open system without supply controls, increasing global competition makes the situation today even more difficult. Threats to economic sustainability of family farmers and the intergenerational transfer of farming as an occupation are thus high. Further, high chemical input and commodity production systems designed to be managed by a single individual (often separate from the owners of the land) have led to serious deterioration of soil quality, water quality, and biodiversity, threatening environmental sustainability. Finally, the current system increases the distance between haves and have nots and threatens community and equity sustainability.

Farming alternatives require new mindsets by farmers and new institutions in rural communities and regions. New farm community entrepreneurial partnerships (FACEPs) can help create both. As we increase awareness of the multiple functions of farming. FACEPs are a mechanism through which the risky shifts required to create new food systems more compatible with all three kinds of sustainability -- increasing the attractiveness of the occupation for coming generations -- can occur.

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SPEAKER PROFILE

Cornelia Butler Flora *is Director of the North Central Regional Center for Rural Development, located at Iowa State University. One of four regional centers in the United States, the NCRCRD combines research and outreach for rural development and covers the twelve North Central states.*

Previously she was head of the Sociology Department at Virginia Polytechnic Institute and State University, University Distinguished Professor at Kansas State University, and program officer for the Ford Foundation. As past president of the Rural Sociological Society, she is author and editor of a number of recent books, including Rural Communities: Legacy and Change, Rural Policies for the 1990s, and Sustainable Agriculture in Temperate Zones. Sh was instrumental in developing the 13-part PBS video course on rural America and part of the course team for the PBS series Americas that focused on Latin America. She has published ove 200 articles and book chapters, primarily on rural development in the United States and developing countries, and is a fellow of the American Association for the Advancement of Science.

Her current research addresses alternative strategies of community development, agriculture and natural resource management, and measurement of community change in North America and Ecuador. She is part of the Sustainable Agriculture and Natural Resource Management Collaborative Research Program.

Her Bachelor of Arts degree is from the University of California at Berkeley in 1965 and her M (1966) and PhD (1970) degrees are from Cornell University, where she received the 1994 Outstanding Alumni Award from the College of Agriculture and Life Science.

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PRAIRIE AGRICULTURE, CLIMATE CHANGE AND SUSTAINABLE ALTERNATIVES[1]

— SURENDRA N. KULSHRESHTHA[2] AND BRUCE JUNKINS[3] —

Abstract

Climate has systematically changed over the last century, and would continue to change in the future. These changes would have a discernible effect on prairie agriculture and through these changes, on the entire prairie landscape. Major impacts of a changing climate include movement of agricultural activities northwards, increased variability in temperature and precipitation regimes affecting crop and livestock production, and increased frequency of drought and floods in the region. However, agriculture is also a part of the cause of climate change through emission of greenhouse gases into the atmosphere, notably carbon dioxide, methane and nitrous oxide. Prairie agriculture in 1990 contributed 41.9 million tonnes of gases (in terms of their global warming potential), which were over half of the Canadian total emissions of these gases from agriculture. By 2010, these emissions are expected to increase by 17% if soils as carbon sinks are not recognized, and by 4% if these are. In a search for sustainable alternatives, reduction of greenhouse gases might be one such criteria. This study suggests that very few mitigation measures appear to be economically desirable for mitigating these emissions. The most economic strategy appears to be the adoption of improved nutrient management. Other strategies would entail new capital investment and thus, may further reduce farm income levels. Adaptation to changing climate is one option, which requires more research and capacity building in the region. However, the basic question remains, whether sustainable agriculture would be more robust in light of climate change, and whether it would contribute less to the future changes of similar phenomenon.

KEYWORD:
Agriculture, Climate change, Adaptation, Mitigation, Greenhouse gas emissions

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[1] Any policy views, whether explicitly stated, inferred or interpreted from the contents of this paper, should not be represented as reflecting the views of Agriculture and Agri-Food Canada.

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Introduction

Weather changes are not a new phenomenon on the Prairies. During this Century alone, farmers have witnessed both short term and long term weather variability, in the form of droughts and floods in various parts of the region. In the future landscape of the Prairies, a new facet of changing weather patterns is added — Climate change. Climate change is related to human activities either directly or indirectly. Human activities alter the global atmosphere, which and in turn, alters the climatic patterns over the longer period of time. The importance of this issue and its interconnectedness with human activities has been recognized more widely since the report of the Second Assessment of the Intergovernmental Panel on Climate Change (IPCC), which stated that "the balance of evidence suggests a discernible human impact on global climate" (see Nicholls et al., 1996). This has certainly enhanced discussions and debates in the public arena on issues surrounding anthropogenic activities inducing climate change.

One of the major issues associated with climate change is the sustainability[4] of the present economic system, particularly in regions already facing constraints at present. Agriculture is one of the major backbones of many countries, and this discussion soon leads to the issue of food security, particularly in those regions that are already food-deficit, and / or are projected to be facing significant shortages in the future. Although Canada, through the contribution of the three prairie provinces in producing food products, is in a fortunate situation of having surplus, leading to exports to various countries, a changing climate may have some effect on this aspect of agriculture. Since agriculture is also a contributor to the climate change, these issues need to be examined in the context of the agriculture sector in the three prairie provinces.

The primary objective of this study is to examine the issue of climate change in the context of prairie agriculture. Implications of such changes on the future agricultural potential are examined. The presentation is divided into six parts: Part one includes a review of climate change and its predicted impacts on society in general. This is followed by a more detailed discussion of the effects of the climate change on prairie agriculture. Approaches to combat climate change are outlined in the third section, which is followed by an examination of contributions made by prairie agriculture towards climate change through emissions of greenhouse gases. The fifth section examines the role of sustainable agricultural alternatives in the context of climate change. The last section summarizes the discussion in the context of sustainable alternatives.

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[4] Sustainability is a complex concept and many definitions have been used. This discussion is postponed to a latter section of this paper.

I. CLIMATE CHANGE

What is Climate Change?

Climate change is a phenomenon that is different from normal variability in weather patterns. According to the United National Framework Convention on Climate Change (as referred to in Houghton et al., 1996), "climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". Under this change, the earth's surface is warmer through a phenomenon called "greenhouse effect". The functioning of this effect is shown in Figure 1. The major cause of this change is trapping of some of the energy in the earth's atmosphere, that could otherwise have been reflected back into the space. The industrial revolution, leading to major industrialization of the western world during the later half of the 20th Century, has seen a major increase in the concentration of carbon dioxide — a gas that is reported to be responsible for global warming. As shown in Table 1, these concentrations have increased from 280 parts per million by volume (*ppmv*) during the early part of this century, to 358 *ppmv* in 1994. In addition to carbon dioxide, two other gases are also responsible for the global warming — methane, and nitrous oxide. Each of these gases differ in two respects: One, their global warming potential is different. Considering a 100- year time horizon, methane creates 21 times more warming than carbon dioxide (CO_2), while the global warming factor for nitrous oxide, over the same time horizon, is 310 times that of CO_2.

1. About 70% of sun's energy that enters the atmosphere reaches the earth.

1. About 30% of the energy is reflected back into space.

2. In addition to water vapor, burning of fossil fuels and deforestation increase carbon dioxide in the atmosphere. Added to this are chlorofluorocarbons (human-made gases used in spray cans, refrigerants, and insulation materials), nitrous oxide, and methane (from landfills, farming and swamps).

3. Together these gases form a "blanket" which traps energy, thus warming the earth.

Source: World Resource Institute, 1989.

Figure 1: HOW DOES THE GREENHOUSE EFFECT WORK?

Table 1:
Selected Characteristics of Greenhouse Gases

Particulars	Unit	Carbon dioxide	Methane	Nitrous oxide
Pre-industrial concentration	ppmv*	280	0.700	0.275
Concentration in 1994	ppmv	358	1.720	0.312
Annual rate of growth during 1984 to 1994	Percent	0.40	0.60	0.25
Global warming potential over 100 years time horizon	CO_2=1	1	21	310
Atmospheric life	Years	50 - 200	12	120

* ppmv parts per million by volume

Source: Houghton et al. (1996)

Two, their respective life in the atmosphere is also different from each other. Carbon dioxide can last in the atmosphere for a period of 50 to 200 years, while methane and nitrous oxide have been estimated to have an atmospheric life of 12 and 120 years, respectively.

These two features of the greenhouse gases have particular implications for the greenhouse gas emissions from agricultural production.

Impacts of Climate Change

Under a changing climate, the world as a whole (including the Canadian Prairies) could experience a variety of changes. Some of these could be detrimental, particularly for agricultural production potential, while others may be beneficial through the development of new opportunities. However, both of these types of changes would impact the socio-economic-political fabric of Canada and the Prairies. The global warming may cause the average temperatures in many parts of the world to increase by 1.5 to 3° C by the latter part of the 21st century. Such an increase would not be felt uniformly throughout the world, thereby creating gainers and losers. Threats to the agricultural potential of Canada and the prairie provinces would be through warmer climate, more variable precipitation, reduced soil moisture, and increased frequency of droughts. For example, Williams et al. (1988) has predicted a thirteen fold increase in the frequency of droughts under climate change. Change in the seasonal patterns of temperature and precipitation may also create havoc for the present day agriculture. These changes would also lead to some indirect effects on the region through linkages with non-farm economic activity in the region, as well as through affecting competitive position of prairie agriculture, leading to changes in external trade linkages.

II. CLIMATE CHANGE AND PRAIRIE AGRICULTURE

The prairie region has an unusual combination of a moderately large economy and an economy that is relatively dominated by climate as compared to other areas of the country (Cohen et al, 1992). The region has been particularly prone to droughts in the past, and water is a limiting factor. Climatic changes will notably affect agricultural production as well as other ecosystems, particularly wetlands, agroforestry, and biodiversity. These would then affect the economic diversity of the region and through that development of rural communities.

Attributes of Climate Change for the Prairie Region

Climate change has been described to have five major effects in weather-related phenomena:
(1) Rise in average temperature;
(2) Change in precipitation, and through that, in net evapotranspiration and available soil moisture; (3) Increase in inter-year and intra-year variability in both precipitation and temperature; (4) Increased probability of extreme events such as droughts and floods; and
(5) Melting of the polar ice cap, resulting in the sea level rise. In the context of the prairie provinces, the last effect would have very little impact, if any.
To examine the nature of change for the prairie provinces, results from the Canadian General Circulation Model of Environment Canada were obtained[5]. These pertained to the likely impacts in Canada by the year 2050. Based on these estimates, for the prairie provinces, it is expected that by 2050, there would be an increase in the temperature of 2.5 to 3.5° C, slight increase or a reduction in the average precipitation by up to 5%, and a decrease in the soil moisture. A major effect of these changes would be a milder climate in the northern latitudes, whereas there would be a relative limitation through soil moisture in the southern parts of the three prairie provinces.

Impact of Climate Attributes on Prairie Agriculture

A changing climate could impact the agriculture industry on the Prairies directly through changing production possibility frontiers, or indirectly through changes in other environments that are related to agricultural production. One such environment is water resources. Both of these types of impacts are summarized in this section.

A. Direct Impacts on Agriculture Through Climate Change

Climate change would strongly affect global and regional agricultural production possibilities, although a certain degree of uncertainty does exist in these estimates. Most studies indicate that rising levels of GHGs are likely to increase the global average surface temperature over the next 100 years, amplify extreme weather events (notably droughts in the drought-prone areas, and floods in high-precipitation low-lying lands), shift climate zones pole-wards, and reduce soil moisture through periods of higher evapotranspiration.

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[5] **Details on the model are available from the Canadian Centre for Climate Modelling and Analysis (CCCma) at http://www.cics.uvic.ca/scenarios/.**

These would have significant implications for Prairie agriculture, which are described below.

1. *Climate and agricultural zones would tend to shift towards the poles*
   The average temperatures are expected to increase more near the poles than near the equator. Some predictions note that the climate in the Southern Prairies would resemble the present-day Nebraska. This may replace the hard spring wheat zone by a winter crop zone (Rosenzweig, 1985). An important effect of the possible increase of winter crops is the improved protection of these crops against soil erosion, especially in the spring when wind erosion occurs (Action, 1991). As climate zones shift northward with global warming, the grey and black soil zone will experience warmer climate and their agriculture production capabilities may improve. Very little evidence of change in productivity has been reported to date for the southern part of the Prairies

2. *Increased regional variability may be experienced.*
   A warmer climate might reduce soil moisture and increase evaporation rates locally or regionally. Predicted increases in temperature would lengthen the growing season for the prairies. The growing season here is defined as the number of days with the daily mean temperature above 5° Celsius. However, for the eastern portion of the Canadian Prairies, a warmer summer may increase evapotranspiration. This may result in some areas with reduced crop yields resulting from limited soil moisture availability. Thus, some parts of Canadian Prairies would benefit from higher temperatures, others might not.

3. *Increased temperature could have positive and negative effects on plants*
   In favorable climate years, weather conditions may match the crop's requirements (heat and moisture), resulting in higher yields. However, a high temperature regime in critical periods, such as flowering and filling, could produce adverse effects on crops yields. Williams et al. (1988) claim that some regions may experience a loss of 10-30 percent in average yields. However, according to Brklacich et al. (1991), the effect of global climate change would be non-uniform over various regions, but the overall effect will be negative. In general, if precipitation increases, it may offset the adverse heat effect, and may even result in increased yields (Wheaton and Wittrock, 1992).

4. *Increased concentrations of CO_2 may increase crop productivity*
   Higher levels of CO_2 should stimulate photosynthesis in certain plants; a doubling of CO_2 may increase photosynthesis rates by as much as 30-100%. Laboratory experiments have confirmed that when plants absorb more carbon, they become more water efficient and therefore grow bigger and more quickly.

This is particularly true for plants such as wheat, rice, and soybean. The response of other plants such as low-latitude crops including maize, sorghum, sugarcane, millet and some pasture and forage grasses, would not be as dramatic (United Nations Environment Programme (UNEP)).

5. *Soil Degradation*
   Soil degradation is very sensitive to weather and climate. Climate change, especially temperature and precipitation would have a strong influence on the chemical and physical processes, such as soil formation (Brady, 1974). As a result of climate change, wind and water erosion could increase as well, especially during drier years (Wheaton and Chakravarty 1990). Effects of wind erosion are numerous, and often severe and costly. Increased temperature and decreased (or more variable) precipitation could also decrease soil organic matter, thereby making soils more susceptible to wind and water erosion.

6. *Effect on Livestock Production*
   Livestock is affected by climate change in two ways: One, directly by temperature extremes; and Two, indirectly by supply of forage and feedgrains. According to Williams et al.(1988), under a 5° C increase in temperature, feed efficiency and perhaps livestock productivity may decrease. There may also be a loss in animal productivity through declining forage quality. However, there may be some benefits for livestock because of shorter and warmer winters, but this may be compensated by increased incidence of diseases and insects. Warmer temperatures, with hotter and drier summers, would induce livestock production to move northward. One of the main problems in livestock production under a climate change would be that of a sufficient supply of good quality water (Williams et al., 1988).

7. *Insects and Diseases that Affect Crops*
   According to Kellog (1989), agricultural losses to insects and diseases in Canada are large, and could increase with climate change. Smith and Tirpak (1989) also stated that warmer winter temperatures could cause an increased range of insects and pests and therefore risk of greater plant damage.

8. *Economic Impacts*
   A warmer climate would have a significant effect on the economic position of farmers. With more frequent droughts in the southern parts of the Prairies, economic activities related to agriculture (directly or indirectly) may decline. Effect on crop production and livestock has been estimated to be substantial across the Prairies, although Alberta faired relatively better than Saskatchewan and Manitoba[6].

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[6] Based on a review of the literature, Brklacich et al. (1998), total crop receipts under climate change are expected to increase by 9% (in constant dollars), while for Saskatchewan, a reduction of 7% is expected, with Manitoba showing no changes.

B. Indirect Impact on Agriculture Through Water Supply

Although the prairie region, comparatively speaking, is endowed with large quantities of water in its lakes and rivers, its distribution is not uniform. Agriculture, being highly dependent on water resources in some regions, has already been experiencing intense competition during periods of water shortages. Under a changing climate, many of the current water users may increase their demand for water. At the same time, the climate change may reduce water supply through more frequent and intense droughts (Williams et al.,1988). These events would produce two types of impacts on agriculture:

(1) Recurring hydrological droughts would reduce the water available for storage, resulting in a reduction of water during these and subsequent years. This may reduce the level of water available for irrigation, except if farmers employ water-efficient irrigation technologies[7]. Since the water efficient irrigation systems are more expensive to install and / or to operate, this may increase the cost of production, and thereby, the relative economics of crop and livestock production in the region.

(2) The demand for irrigation may also increase under the climate change, particularly in the southern parts of the prairies. This may be the result of more frequent droughts in the region. Such increases may result in restrictions being placed on water use for irrigation.

Increasing climatic uncertainty will also change the way decisions are made about development of irrigation projects and may alter the image it now has. In some regions, economic benefits from irrigation may increase, making such projects more socially desirable. Water quality may possibly decrease in irrigation areas because of the higher projected evapotranspiration rates that will occur with the higher temperatures. Interprovincial conflicts in the use of water may also rise due more frequent water shortages.

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[7] Different types of irrigation systems have a different water use efficiency. For example, flood irrigation systems use the most amount of water per unit of production. Much of this water is drained off the field and thus not available to the crops. On the other extreme, drip irrigation systems provide water to the root zone of the plant and are very efficient. In the middle are the sprinkler systems, including low-nozzle systems, which provide water more efficiently than the flood irrigation systems.

III. ACTIONS TO COMBAT CLIMATE CHANGE

Mitigation versus Adaptation

Combating the adverse effects of global warming has been discussed with two separate philosophies. In the first philosophy, the effect of global warming is minimized, if not totally eliminated, through reducing greenhouse gas emissions into the atmosphere. Believers in this option suggest that through proper reduction in the GHGs, climate change could be slowed down, or even totally averted. In contrast, critics of this philosophy suggest that it is already too late to reverse the trends in global warming. These individuals propose to follow a different philosophy — adaptation to climate change. Adaptation involves development of strategies to cope with adverse climatic events, or to reduce their adverse effects through appropriate management options. Supporters of this philosophy assume that climate change is inevitable, and the society must prepare to cope with it. Critics of this philosophy suggest that adaptation means accepting the fact that we have failed in our efforts to reduce GHG emissions and thereby in averting the adverse effects of global warming.

International Efforts to Mitigate Global Climate Change

Most international efforts in the early works of the Intergovernmental Panel for Climate Change have been related to philosophy one: mitigation of GHG emissions. The first serious attempt made by the world community to address the global change was in 1992, at the "Green Summit", where various countries, including Canada, agreed to take some actions towards mitigating climate change. As a starting point, various countries agreed to develop an inventory of greenhouse gas (GHG) emissions. However, no particular targets for reduction of GHG emissions were set at this Summit. The assembly of these countries reconvened in 1998 in Kyoto. The progress made in reducing GHG emissions as well as other objectives set under the Green Summit were reviewed. At this point, various countries agreed to set targets for reducing GHG by the 2008-2012 period. Canada at this meeting agreed to reduce its GHG emissions to 6% below the 1990 level by this period. This agreement is commonly called the "Kyoto Protocol".

Within Canada, subsequent to signing the Kyoto Protocol, the federal government instituted a mechanism to develop a National Implementation Strategy for 14 fourteen Issue tables, one of which was to deal with the agriculture and agri-food sector. In more recent periods, federal emphasis is more balanced between mitigation and adaptation. The latter strategies are being developed under the auspices of the Climate Change Action Fund.

One of the prerequisites to mitigation is the knowledge of contributions to GHG emissions made by various economic sectors in the prairie provinces. Such contributions made by Prairie agriculture are reported in the next section.

IV. CONTRIBUTION OF AGRICULTURE TOWARDS CLIMATE CHANGE

Sources of Greenhouse Gas Emissions from Agriculture

Agricultural production involves a number of cultural and agronomic practices, many of which are linked to emissions of GHGs. This assessment is complicated by the fact that some of the fluxes of these gases are considered to be a part of the natural cycle, and therefore, non-anthropogenic. Therefore, these sources are not included under the agricultural emissions of GHGs reported under the Kyoto Protocol. Major processes that produce GHG emissions through anthropogenic activities are related to the basic production activities — crops and livestock. For crop production, activities such as tilling of land, application of fertilizer / manure, production of nitrogen fixing crops, and decomposition of crop residues are the main processes related to GHG emissions. Similarly for livestock production, enteric fermentation from farm animals, and the management and application of their excretions are the major sources of methane and nitrous oxide.

In addition to direct emissions of GHGs, agriculture also contributes to emissions indirectly. These indirect emissions are related mainly to two processes — atmospheric deposition and leaching of nitrogen, subsequently becoming emissions of nitrous oxide.

Agricultural GHG emissions in the Canadian inventory of GHG emissions exclude those from energy sources. This is done to avoid double-counting, since such emissions are estimated as a part of the total energy use based emissions. A further complication in accounting for agricultural GHG emissions is the stipulation of the Kyoto Protocol which instructs countries not to include carbon sequestration in soils.[8] However, in order to obtain a complete picture of agricultural GHG emissions, in this study both of these emissions are counted as a part of the farm level emissions.

To extend the emissions from the primary agricultural activities to the entire agri-food sector, one should also include the induced emissions — activities that are present in the region only because of agricultural production. These include manufacturing of farm inputs (fertilizer, fuel, pesticides, and farm machinery and equipment), off-farm transportation and storage, and further processing of raw materials produced by agriculture. These emissions, combined with the farm level emissions, constitute total GHG emissions from the agriculture and agri-food sector.

Estimation of Greenhouse Gas Emissions from the Prairie Region

Emissions of carbon dioxide, methane and nitrous dioxide were estimated using the Canadian Economic and Emissions Model for Agriculture (CEEMA)[9]. In this model, an economic decision making sub-model for the farm level is linked with a greenhouse gas emissions sub-model. Thus, the model has the capability of simulating the effect of changes in economic conditions and / or policy regimes on GHG emissions from agriculture.

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[8] The soils as carbon sinks are currently under negotiation.

[9] For further details, see Junkins et al. (Forthcoming).

In the CEEMA, accounting of GHG emissions was done at three levels: (1) Emissions recognized under the Kyoto Protocol, which are the same as those reported by the Canadian GHG Inventory. These will be referred to as the Kyoto Agriculture emissions, (2) Direct Farm level emissions, and, (3) Agriculture and Agri-food Sector (AAFS) level emissions. These accounting levels are sequential in nature -- the direct farm level emissions include the Kyoto Agriculture level emissions, and the AAFS level emissions include the direct farm level emissions. Emissions of GHG for each of the above-noted three levels were estimated for two time periods: 1990 and 2010. Agricultural production levels for 2010 were based on AAFC's Medium Term Baseline (1998).

Estimated 1990 Agricultural Emissions of Greenhouse Gases in the Prairie Region

During 1990, the three prairie provinces' agriculture and agri-food sector emitted a total of 60 million tonnes of carbon dioxide equivalent (CO_2-Eq)[10] GHG. As shown in Table 2, over half of these emissions (35.9 million tonnes) were at the Kyoto Agriculture level, and included those from the use of non-energy inputs in crop and livestock production, and their indirectly-related processes linked to GHG emissions. Use of energy adds another 6 million tonnes to the agricultural emissions, bringing it to a total of 41.9 million tonnes of CO_2-Eq emissions of GHGs at the farm level. Agricultural soils in the Prairies were not net carbon sinks in 1990.

The Prairie region is a major contributor to the total Canadian agricultural GHG emissions. As shown in Figure 2, for all GHG more than half of the total Canadian GHG emissions are contributed by the Prairies. The region is a major emitter for carbon dioxide and nitrous oxide. This proportion is 82% of the total Canadian agricultural emissions for CO_2, whereas for methane and nitrous oxide these shares are, respectively, 52% and 65%. A relatively lower proportion for methane is on account of larger beef and dairy enterprises in Eastern Canada.

Future Level of Emissions from the Prairie Agriculture

Prairie agriculture's GHG emissions by 2010 are estimated to be higher at all three levels of accounting relative to the 1990 level. At the Kyoto Agriculture level, the increase is predicted to be 20% of the 1990 baseline level. Major increases in emissions are expected from livestock production, where an increase of 35.5% over the 1990 baseline is estimated. Crop production related emissions are expected to decline, primarily because of the increased adoption of conservation tillage systems, and reductions in the use of summerfallow, which would lead to sequestration of soil carbon in various parts of the prairies. GHG emissions are also estimated to decline, through soil

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[10] Carbon dioxide equivalent levels of GHG emissions refer to the level that is based on the the global warming potential of each gas. As noted earlier, methane is multiplied by 21, and nitrous oxide by 310, to obtain CO_2-Eq quantities.

Source: CEEMA output

Figure 2:Distribution of Canadian Greenhouse Gas Emissions at the Direct Farm Level, from prairie and Non-Prairie Agriculture in Canada, by Type of Gas, 1990

Table 2: Estimated Emissions from Prairie Agriculture, 1990 and 2010

Activity	Emissions in CO_2-Eq Million Tonnes		Change during 1990 -2010 period in M.T.	% Change from 1990 Base
	1990	2010		
Crop Production	14.02	11.66	-2.36	-17.0
Livestock Production	16.75	22.70	5.95	35.5
Indirect Emissions	5.81	9.60	3.79	65.2
Agroecosystem Emissions*	-0.68	-0.76	-0.08	-11.8
Kyoto Agriculture Level Emissions	35.90	43.20	7.30	20.3
Energy Use Emissions	6.01	5.94	-0.06	-1.0
Soil Carbon Sequestration	0	-5.52	-5.52	–
Direct Farm Level Emissions	41.91	43.62	1.71	4.1
Farm Input Manufacturing	16.20	18.64	2.44	15.1
Off-farm Transportation and Storage	1.16	1.63	0.47	40.9
Food Processing	0.88	1.76	0.77	99.5
Agri-Food Level Emissions	60.15	65.65	5.50	9.1

- Includes farm shelterbelts, uptake of methane by soils, and release of methane by wetlands.

Source: CEEMA output

carbon sequestration activities which are included at the direct farm level[11], as well as through declining fuel use on farms. When both energy and non-energy inputs and sequestration activities are added together, the increase in GHG emissions over the 1990 level is only 1.7 million tonnes (in CO_2-Eq quantities). If soil carbon sequestration is excluded, direct farm level emissions in 2010 would increase by 17.3% of the 1990 baseline emissions.

Distribution of the Prairie region's GHG emissions by province suggests that Alberta has the largest contribution at the Agri-Food Level, followed by Saskatchewan and Manitoba. The shares of these provinces also remain fairly stable over the 1990-2010 period, with Alberta and Manitoba increasing only slightly, while Saskatchewan is decreasing. The reduction for Saskatchewan is brought about primarily through soil carbon sequestration.

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[11] Under the present set of rules, soil carbon release (source) into the atmosphere is accounted as a part of the crop production emissions, whereas the soils as carbon sinks (through sequestration) are not included at this level. These are added at the farm level as sinks in this study.

V. ROLE OF SUSTAINABLE AGRICULTURAL PRACTICES IN THE CONTEXT OF CLIMATE CHANGE

In the context of climate change, sustainability holds a special place. The fact that global climate change may occur, and that conventional agriculture as practiced today is one of the major contributors to it, suggests the need for sustainable agricultural practices to be adopted by the industry. Two aspects of the interrelationships between climate change and sustainable agriculture are noteworthy:

(1) Would sustainable agriculture contribute less to emissions of greenhouse gases and thereby postpone the adverse effects of climate change?, and

(2) Would a sustainable agriculture sector be less vulnerable to climatic fluctuations?

At least on the second topic, unfortunately very little research has been undertaken in Canada (or for North America). The review in this section is based on a meta-analysis of data and information that exists on these and related topics.

What is meant by Sustainability?

The very fist issue that one must tackle in identifying interrelationships between climate fluctuations and sustainable agriculture is to define it in a manner which can be measured or clearly identified. The major problem presented here is a lack of clear-cut answers to a number of issues in this context. These include, among others:

(A) Is sustainability a goal or a set of prescriptive practices?, and,

(B) What is meant by sustainability?

Answers to the first question do vary. Some regard sustainability as a process while others contend that it is simply a goal. This stands in the path of developing a clear definition of sustainable agriculture. As a result, a number of farming systems have been identified as being sustainable. Nomenclature used includes: Alternative agriculture, Low-Input sustainable agriculture, Ecological / Ecobiological / Sociological agriculture, Regenerative / Permaculture agriculture, Biodynamic agriculture, and Organic agriculture.

Coming to the second issue — what is sustainability, the original definition of the concept was provided by the World Commission on Environment and Development (WECD, 1987). The Commission stated that development is sustainable if it "...meets the needs of the present without compromising the ability of the future generations to meet their needs." (WECD, 1987, p. 8). Although this definition provides a good stating point, to translate it into a specific industry (such as agriculture) has not been easy. However, some authors, such as Harwood (1990) have used this type of concept to define sustainable agriculture as follows: Agriculture "...evolves indefinitely towards greater human utility, greater efficiency of resource use, and a balance with the environment that is favorable both to humans and to most other species".

Further debates on the concept of sustainability are created by differences in the way various disciplines approach the concept. For example, one can identify two types of sustainability: (1) Weak Sustainability, and Strong Sustainability. Weak sustainability, which is preferred by economists, which suggests that sustainability is achieved if the total capital stock does not decline. This total capital stock is measured as follows:

$$\text{Total Capital Stock} = \text{Man-made Capital} + \text{Natural Capital} \qquad (1)$$

Thus, in this notion of sustainability, natural capital can be substituted by man-made capital. With this line of thinking, technology will bring forth substitution of natural capital, thus providing sustainability.

In contrast, strong sustainability is preferred by ecologists. In this line of thinking the two types of capital are not substitutable. Thus, neither the natural stock nor the man-made capital stock should decline. Under this school of thought, natural capital imposes an absolute constraint on development

Evaluation of Sustainability

Since sustainability touches upon at least three aspects — economic, social and environmental, its evaluation must be done using criteria relevant for measuring these impacts. Thus, a very broad approach is needed. Comprehensive studies of such evaluation are few, if any. Some studies did attempt to focus on a narrower aspect of sustainable agriculture. These are reviewed in this section.

Economic Sustainability

Economic desirability of alternative (sustainable agriculture) is heavily dependent on two factors: One, whose accounting stance is taken?, and Two, whether all benefits and costs are accounted for? Using corn-soyabean production in the U.S. as an example, differences in economic returns are shown in Table 3. Coming back to the two factors presented above, the first factor leads to two separate accounting stances — one for the private individuals, and the other for the society as a whole. The major difference between the two is the scope of impacts of agriculture to be included in the analysis. Conventional corn production from the point of view of producers is profitable (with a net return of $91/acre). However, loss of natural capital is not included here. If one follows the natural resource accounting (or green accounting), the producers' net returns are reduced to $67/acre. Now if we were to use the society's accounting stance and conventional accounting system, we have to eliminate the subsidies (since these are transfer payments), thereby reducing the net returns to society from corn production to $75/acre. However, at this point a number of off-farm costs have been ignored. If the cost of soil depreciation, and cost to the rest of society from soil erosion are

Table 3: Corn-Soyabean Rotation in Pennsylvania ($/ac/yr)

Items	Private Accounting		Society's Accounting	
	Conventional Accounting	Natural Resource Accounting	Conventional Accounting	Natural Resource Accounting
Gross Operating Margin	75	75	75	75
Less Soil Depreciation	–	24	–	24
Net Farm Operating Income	75	51	75	51
Plus Government Subsidy	16	16	–	–
Less Off-site Costs of Soil Erosion	–	–	–	49
Net Farm Income / Net Economic Value	91	67	75	2

Source: Faeth (1993)

accounted for, net returns from corn production to the society are only $2/acre. If sustainable agricultural practices are adopted, thereby reducing the soil erosion, and subsidies are eliminated, alternative agricultural practices could be more socially desirable.

Social Sustainability: Community Development:

Social sustainability is relatively more complex to define. Traditionally, this type of sustainability is perceived in terms of improvements in quality of life of people in the rural areas. Many aspects of economic, social and environmental factors contribute to the level of quality of life index. In the context of prairie agriculture, viability of rural communities is a major factor determining social sustainability. Rural

Table 4:
Change in Employment following Conversion to Organic Farming

Type of Employment		Average Increase per Farm
Family	Full-time	0.41
	Part-time	0.33
	Casual	0.19
Hired Workers	Full-time	0.24
	Part-time	0.47
	Casual	0.64
All workers		2.28

Source: Bowler (1992)

communities remain viable as long as the population base in rural areas remains stable or increases over time. Population, in turn, is related to employment by farmers and related industries.

Unfortunately studies for the prairie provinces documenting employment changes resulting from alternative agricultural practices have not been undertaken. As a poor substitute, results from a u. k. study by Bowler (1992) are shown in Table 4. According to this study, conversion of farms to organic agriculture (one of the ways in which agriculture can become sustainable) increases the labor demand on farms. On a per farm basis, a typical sample farm in this study added 2.28 full-time equivalent workers, of which 40% were family workers and the remaining 60% were hired workers. The former type of workers would keep more family members at home, whereas the latter types of employment would attract more families to the rural areas. Both of these would result in an increase in the population base of the rural communities.

Environmental Impacts

Although agricultural activities and environmental changes are related in many different ways, two aspects are worthy of mention: Energy use and Emissions of greenhouse gases. On the energy consumption aspect, certain types of sustainable agriculture provide a distinct advantage over the conventional agricultural systems. Using data provided by Piementel et al. (1989), a comparison of conventional and alternative systems is provided in Table 5. The ratio of output to input energy for the conventional corn production in the U.S. is 3.31, which increases to 3.63 under no-till systems, and further to 6.73 for the low-input alternative systems.

Another aspect of environmental change is the global climate change through emissions of greenhouse gases. To examine the possibility of identifying more environ-mentally friendly practices, several mitigation practices were identified by the Agriculture and Agri-Food Issue Table, and their effect on the total agricultural emissions estimated using the CEEMA. Since agriculture contributes more methane and nitrous oxide than carbon dioxide, the focus of selected strategies was on reducing the emissions of these gases. In total, nine possible strategies in six areas were analyzed, which are described in Table 6. Areas of focus included better soil nutrient management through

Table 5: Energy Dependence in Corn Production in U.S.

Particulars	Conventional System	No-Till and Rotation	Low-Input Alternative System
Labor (Hours/ha)	10	7	12
Fuel (Litre/ha)	115	70	70
Total Energy (10^3 kcal/ha)	7,845	7,172	3,862
Output/Input Energy Ratio per ha	3.31	3.63	6.73

Source: Adapted from Pimentel et al. (1989).

matching crop nutrient needs based on soil testing. This resulted in reduced nitrous oxide emissions. The second area of focus was soil management through adoption of conservation tillage systems, and converting marginal lands to forage cover over multi-years with a corresponding increase in cattle production as an outlet for the increased forage.

The third area was related to grazing management through rotational and complimentary grazing systems, as well as through reducing the cattle stocking rates on native rangelands. The fourth area of focus dealt with the feeding of animals either through changing their diets or providing better quality forages to beef cattle. Manure management was the fifth area and included two strategies — covering the liquid manure tanks, thereby reducing emissions, or removing the fall application of manure or fertilizer, thereby reducing the loss of soil nutrients during the

Table 6: Mitigative Measures to Reduce Greenhouse Gas Emissions from Prairies Agriculture

Scenario No.	Area of Focus	Description	Total GHG Emissions Reduction at the Farm Level in CO_2-Eq Kilotonnes	Short-run (Non-Capital) Cost** per tonne in $
1	Soil Nutrient Management	Match Fertilizer Application to Needs Using Soil Testing	734	"-"
2	Soil Management	Adoption of Minimum and Zero Till Systems	2,057	"+"
3		Converting Marginal Lands to a Multi-Period Forage Cover with Some Adjustments in Cattle Numbers	19	"—"
4	Grazing Management	Rotational and Complementary Grazing and Reduced Cattle Stocking Rates on Native Rangelands	1,434	"-"
5	Feeding Management	Change Diets for Pigs, Poultry, and Dairy Cattle	256	"+"
6		Improve Forage Quality for Beef Cattle	140	"++"
7	Manure Management	Cover Liquid Manure Tanks	543	"+"
8		Remove Fall Application of Manure	84	"++"
9	Agro-forestry	Increase Shelterbelts to 1% of Crop Area	2,094	"+"

** A negative sign in this column implies a gain in producer surplus from adopting the mitigation strategy. A □+□ sign implies a cost to the producers. Higher cost / benefit strategies are identified as □+++□/ □—□, medium cost / benefits ones as □++□/ □--□, and low cost / benefits ones as □+□ / □-□.

Source: CEEMA output

spring thaw period which also results in reduced applications of non-organic fertilizer. The last area involved planting shelterbelts as a means to sequester carbon from the atmosphere.

These strategies differed from each other in two respects: One, their potential for reducing GHG emissions from prairie agriculture was different; and Two, the benefits(or losses) to producers in terms of operating revenue (net cash income) before any adjustments for capital costs for adopting such strategies were also different. These results are also shown in Table 6. One of the strategies, the multi-period forage program, was GHG neutral. There was a large net benefit to producers for this strategy due to the increase in cattle production, and this combined with the rather small potential for mitigation results in a relatively high per tonne benefits. Two of the strategies — soil nutrient management, and grazing management measures, are what one could call the "win-win" strategies. Here the GHG emissions are reduced as well as farmers being better off financially in terms of operating net income[12]. The rest of the six strategies resulted in costing the producers. This cost was the lowest for covering liquid manure tanks, and highest for improving forage quality for beef cattle.

Adaptation Possibilities to a Changing Climate on the Prairies

Another aspect of sustainability may be described from the point of view of its resilience in coping with the changing climate. Here farmers may search for some adaptation measures. The key to crop production to adapt to climate change is the predictability of the conditions (Herrington et al., 1997). If conditions can be forecasted in advance, adaptation would be more effective. This requires strengthening our ability to make longer term climate forecasts.

Since the major impact of the climate change would be in terms of changes in temperature and precipitation regimes, and increased frequency of droughts and floods, adaptation measures would, by necessity, have to be related to stress created by these aspects. However, this has not been a well researched area in the Prairies[13], and precise recommendations must await authoritative research. Although a precise list of adaptation measures must await a more detailed impact assessment of climate change on various parts of the Prairies, the following list of measures could become the focus of future work.

1. Capacity building would have to be a major activity in developing adaptation measures for Prairie agriculture. This would include educating farmers and farm input industries,

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[12] It should be noted that in these estimates not all capital costs are included. Therefore, the costs are only partial costs.

[13] This is not to suggest that some aspects of climate change have not been addressed. During the early 1980s, the Saskatchewan and Manitoba Drought Studies addressed the issues related to drought in a comprehensive manner. A partial list of drought mitigation measures for Saskatchewan can be found in Marv Anderson and Associates (1983).

as well as developing institutions, private or public, dealing with these issues. The need for improved dissemination of information and education of the agricultural community with respect to the use of climate change related information and its application to risk management has been identified as a priority area by Herrington (1997).

2. Change in land use might be one way in which the adverse effects of a changing climate could be remedied. This might include growing drought resistant crops, different rotational systems, different tillage systems, more diversification through livestock operations, or newer more exotic crops that would flourish well in the warmer and longer growing season.

3. Development of research aiming at measures (including new crops and varieties) reducing the adverse effect of climate change. Water management would also a topic for further research in terms of their adaptability on the Prairies.

4. Development of an irrigation infrastructure may become a necessity for some parts of the Prairies. However, since water supply may dwindle, and its demand would be on the rise, new measures / rules would be required to use water efficiently. Capturing more of the return flow from irrigation would have to be considered more seriously under these conditions.

5. Development of controlled-environment agriculture and aquaculture may become more economical in the changing climate.

6. Measures such as the use of stubble mulches to retain soil moisture, minimization of soil tillage, more strip farming, proper snow management techniques, among others, may become more popular under the warmer and more variable climate.

7. For livestock operations, grazing drought damaged crops, better grazing management and building larger feed reserves are some of the commonly advocated adaptation measures for a drier and warmer climate.

The above list of adaptation measures is not exhaustive, but it provides a good starting point in this area. More research is needed to develop appropriate adaptation measures for various parts of the Prairies. However, any farming systems that adopt these or similar practices would be more resilient in the wake of climate change.

VI. SUMMARY:
CLIMATE CHANGE AND SUSTAINABLE AGRICULTURE

Climate change has the potential to modify the landscape of the Prairies. Such modifications would be experienced both spatially, as well as in terms of how farmers would do the business of farming in the future. However, although agriculture is a part of the problem, it could also be a part of the solution. Greenhouse gas emissions from Prairie agriculture in CO_2-Equivalent (at the farm level) have been estimated to be 41.9 million tonnes, and are expected to rise to 43.6 million tonnes. This includes however, soils carbon sequestration, a phenomenon that could enable agriculture to be a part of the solution.

With the changing climate, several issues arise that need to be addressed properly. One of the foremost concerns of a changing climate is the sustainability of prairie agriculture. Sustainability has at least three major elements: Social, Economic and Environmental. The social aspect of sustainability relates to people and the ability to maintain social and cultural systems in a changing climate. The economic element is concerned about obtaining maximum flow of income from the resources employed in agriculture while maintaining the stock of such resources that yield these benefits. The environmental aspect of the sustainable agriculture relates to the resilience of biological and physical systems under changing climates. Would Prairie agriculture continue to remain as sustainable as at present or would the degree of sustainability be affected by the changing climate? The answer to this question is not easy to find.

The social aspect of sustainability gives rise to the concerns related to equity and social issues. Two types of equity issues would emerge under a changing climate regimes: Spatial equity, and Inter-generational equity. The former is concerned about the relative shifts in the economic fortunes of farmers in various parts of the region under a changing climate, while the latter is related to the control of resources by the future generations (based on decisions made by the present generation), particularly as related to the capacity of the environment affecting the industry.

Another complicating force in any meaningful discussion of measures to counteract the effect of climate change is the uncertainty. Two types of uncertainties are present: (1) Scientific Uncertainty -- in terms of scientific knowledge related to the magnitude of the changes in climate and its likely impact on the society; and (2) Socioeconomic Uncertainty — in terms of reactions of society to the climate change and the manner in which social communities would adapt to the changing climate. Both of these affect the ability to predict the specific changes in the future landscape on the prairies.

Many complex interactions may occur under a changing climate regime (Wheaton, 1994). Many of these would shape the future landscape of the prairie region. Agriculture operating under the new socio-economic environment would interact with the economic diversity of the region, which may alter the population dynamics, community settlement patterns, and infrastructure development, among others. ✪

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SPEAKER PROFILE

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He has published extensively in areas of applied forecasting, transportation economics, water resource economics, forestry economics, economic impact analysis, and climate change including greenhouse gas emissions and analysis of mitigation options. He has over 360 publications to his credit, with over 90 in refereed journals. In addition, he has also served as joint editor of the Canadian Journal of Agricultural Economics (1981-84), Associate editor of the Canadian Water Resources Journal (1989-92), and Regional Edito of the Impact Assessment Journal of the International Association for Impact Assessment.

REVISITING CARRYING CAPACITY: AREA-BASED INDICATORS OF SUSTAINABILITY

— WILLIAM E. REES —

Dr. Rees presented the concept of 'Ecological Footprints' to the 2000 conference. I feel it is important that it becomes more widely known because of the lessons we can learn from it. Sustainable agriculture, after all, has everything to do with carrying capacity.

One of the interesting questions when discussing sustainable agriculture is: 'Has agriculture ever been sustainable?' My answer is a clear 'yes'. Sustainability in agriculture has always depended on farming practices, political systems, and the population, which had to be fed. Farming practices were based on the knowledge of the day and the willingness or wisdom of the political and religious leaders to support the food producing capability of the farming population. The first cities in history could evolve because agriculture developed to a point that enough surplus food was produced by farmers to support a non-farming population. The reverse is also true: entire empires collapsed because of neglect of the water and land resource. In other words, the carrying capacity of the land was over exploited. The combination of a growing population, reckless resource use and the suppression and exploitation of the farming population reduced productivity per land unit and per capita of the total population. The usual response was war and/or emigration. The history of Europe and the settling of the Americas by Europeans is only one example.

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— Hart Haidn, May 2001

Conventional wisdom suggests that because of technology and trade, human carrying capacity is infinitely expandable and therefore virtually irrelevant to demography and development planning. By contrast, this article argues that ecological carrying capacity remains the fundamental basis for demographic accounting. A fundamental question for ecological economics is whether remaining stocks of natural capital are adequate to sustain the anticipated load of the human economy into the next century. Since mainstream (neoclassical) models are blind to ecological structure and function, they cannot even properly address this question. The present article therefore assesses the capital stocks, physical flows, and corresponding ecosystems areas required to support the economy using "ecological footprint" analysis. This approach shows that most so-called "advanced" countries are running massive unaccounted ecological deficits with the rest of the planet. Since not all countries can be net importers of carrying capacity, the material standards of the

wealthy cannot be extended sustainability to even the present world population using prevailing technology. In this light, sustainability may well depend on such measures as greater emphasis on equity in international relationships, significant adjustments to prevailing terms of trade, increasing regional self-reliance, and policies to stimulate a massive increase in the material and energy efficiency of economic activity.

WHY CARRYING CAPACITY?

According to Garrett Hardin (1991), "carrying capacity is the fundamental basis for demographic accounting." On the other hand, conventional economists and planners generally ignore or dismiss the concept when applied to human beings. Their vision of the human economy is one in which "the factors of production are infinitely substitutable for one another" and in which "using any resource more intensely guarantees an increase in output" (Kirchner *et al.*, 1985). As Daly (1986) observes, this vision assumes a world "in which carrying capacity is infinitely expandable" (and therefore irrelevant). Clearly there is great division over the value of carrying capacity concepts in the sustainability debate.

This article sides solidly with Hardin. I start from the premise that despite our increasing technological sophistication, humankind remains in a state of "obligate dependence" on the productivity and life support services of the ecosphere (Rees, 1990). Thus, from an ecological perspective, adequate land and associated productive natural capital are fundamental to the prospects for continued civilized existence on Earth. However, at present, both the human population and average consumption are increasing while the total area of productive land and stocks of natural capital are fixed or in decline. These opposing trends demand a revival of carrying capacity analysis in sustainable development planning. The complete rationale is as follows:

Definitions: Carrying Capacity and Human Load

An environment's carrying capacity is its maximum persistently supportable load (Cattan 1986).

For purposes of game and range management, carrying capacity is usually defined as the maximum population of a given species that can be supported indefinitely in a defined habitat without permanently impairing the productivity of that habitat. However, because of our seeming ability to increase our own carrying capacity by eliminating competing species, by importing locally scarce resources, and through technology, this definition seems irrelevant to humans. Indeed, trade and technology are often cited as reasons for rejecting the concept of human carrying capacity out of hand. [According to orthodox theory, free trade is invariably good, resulting in improved living standards and increased aggregate productivity and efficiency -- increased carrying capacity -- through comparative advantage.]

This is an ironic error -- shrinking carrying capacity may soon become the single most important issue confronting humanity. The reason for this becomes clearer if we define carrying capacity not as a maximum population but rather as the maximum "load" that can safely be imposed on the environment by people. Human load is a function not only of population but also of *per capita* consumption and the latter is increasing even more rapidly than the former due (ironically) to expanding trade and technology. As Catton (1986) observes: "The world is being required to accommodate not just more people, but effectively 'larger' people . . ." For example, in 1790 the estimated average daily energy consumption by Americans was 11,000 kcal. By 1980, this had increased almost twenty-fold to 210,000 kcal/day (Catton 1986). As a result of such trends, *load* pressure relative to carrying capacity is rising much faster than is implied by mere population increases.

The Ecological Argument

Despite our technological, economic, and cultural achievements, achieving sustainability requires that we understand human beings as ecological entities. Indeed, from a functional perspective, the relationship of humankind to the rest of the ecosphere is similar to those of millions of other species with which we share the planet. We depend for both basic needs and the production of artifacts on energy and material resources extracted from nature and all this energy/matter is eventually returned in degraded form to the ecosphere as waste. The major material difference between humans and other species is that in addition to our biological metabolism, the human enterprise is characterized by an industrial metabolism. In ecological terms, all our toys and tools (the "capital" of economists) are "the exosomatic equivalent of organs" (Sterrer, 1993) and, like bodily organs, require continuous flows of energy and material to and from "the environment" for their production and operation. It follows that in a finite world:

- Economic assessments of the human condition should be based on, or at least informed by, ecological and biophysical analyses.
- The appropriate ecological analyses focus on the flows of available energy/matter (essergy) particularly from primary producers--green plants and other photosynthesizers -- to sequential levels of consumer organisms in ecosystems (specifically, humans and their economies) and on the return flows of degraded energy and material (wastes) back to the ecosystem.

This approach shows that humankind, through the industrial economy, has become the dominant consumer in most of the Earth's major ecosystems. We currently "appropriate" 40% of the net product of terrestrial photosynthesis (Vitousek *et al.*, 1986) and 25-35% of coastal shelf primary production (Pauly & Christensen, 1995), and these may be unsustainable proportions. [Global fisheries yields have fallen since 1989.] At the same time some global waste sinks seem full to overflowing.

A fundamental question for *ecological* economics, therefore, is whether the physical output of remaining species populations, ecosystems, and related biophysical processes (i.e., critical self-producing natural capital stocks -- see Box 1), and the waste assimilation capacity of the ecosphere, are adequate to sustain the anticipated load of the human economy into the next century while simultaneously maintaining the general life support functions of the ecosphere. This "fundamental question" is at the heart of ecological carrying capacity but is virtually ignored by mainstream analyses.

Box 1: On Natural Capital

Natural capital refers to "a stock [of natural assets] that yields a flow of valuable goods and services into the future." For example, a forest or a fish stock can provide a flow or harvest that is potentially sustainable year after year. The stock that produces this flow is " natural capital" and the sustainable flow is "natural income." Natural capital also provides such services as waste assimilation, erosion and flood control, and protection from ultra-violet radiation (the ozone layer is a form of natural capital) These life support services are also counted as natural income. Since the flow of services from ecosystems often requires that they function as intact systems, the structure and diversity of the system may be an important component of natural capital.

There are three broad classes of natural capital: *Renewable* natural capital, such as living species and ecosystems, is self-producing and self-maintaining using solar energy and photosynthesis. These forms can yield marketable goods such as wood fibre, but may also provide unaccounted essential services when left in place (e.g., climate regulation). *Replenishable* natural capital, such as groundwater and the ozone layer, is non-living but is also often dependent on the solar "engine" for renewal. Finally, non-renewable natural capital such as fossil fuel and minerals, are analogous to inventories - any use implies liquidating part of the stock.

This article takes the position that since adequate stocks of self-producing and replenishable natural capital are essential for life support (and are generally non-substitutable), these forms are more important to sustainability than are non-renewable forms.

Source: Rees (1995), liberally adapted from Costanza and Daly (1992).

Second Law Arguments

A related rationale for revisiting carrying capacity flows from consideration of the Second Law of Thermodynamics. In particular, modern formulations of the second law suggest that all highly-ordered systems develop and grow (increase their internal order) "at the expense of increasing disorder at higher levels in the systems hierarchy" (Schneider & Kay, 1992). In other words, complex dynamic systems remain in a nonequilibrium state through the continuous dissipation of available energy and material (essergy) extracted from their host environments. They require a constant input of energy/matter to maintain their internal order in the face of spontaneous entropic decay. Such self-organising nonequilibrium systems are therefore called "dissipative structures."

This extension of the second law is critical to human carrying capacity. Consider that:

- The human economy is one such highly-ordered, dynamic, far-from equilibrium dissipative structure. At the same time . . .

- The economy is an open, growing, subsystem of a materially closed, nongrowing ecosphere (Daly,

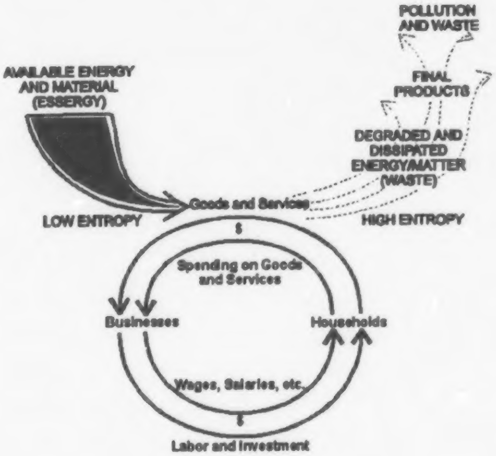
> 1992), and is therefore dependent on the formation of essergy in the ecosphere for its growth and developments. [This input to the economy from nature is the "natural income" referred to in Box 1]

This relationship implies that beyond a certain point, the continuous growth of the economy can be purchased only at the expense of increasing disorder or entropy in the ecosphere. This is the point at which consumption by the economy exceeds natural income and would be manifested through the continuous depletion of natural capital --reduced biodiversity, air/water/land pollution, deforestation, atmospheric change, etc. In other words, the empirical evidence suggests that the aggregate human load already exceeds, and is steadily eroding, the very carrying capacity upon which the continued humane existence depends. Ultimately this poses the threat of unpredictable ecosystems restructuring (e.g., erratic climate change) leading to resource shortages, increased local strife, and the heightened threat of ecologically induced geopolitical instability.

In this light, the behavior of complex systems and the role of the economy in the global thermodynamic hierarchy should be seen as fundamental to sustainability, yet both concepts are alien to the dominant development-oriented institutions in the world today.

Why Economics Cannot Cope

FIGURE 1. The linear throughput of energy/matter


POLLUTION AND WASTE
AVAILABLE ENERGY AND MATERIAL (ESSERGY)
FINAL PRODUCTS
DEGRADED AND DISSIPATED ENERGY/MATTER (WASTE)
Goods and Services
LOW ENTROPY
HIGH ENTROPY
$
Spending on Goods and Services
Businesses
Households
Wages, Salaries, etc.
$
Labor and Investment

The linear throughput of low-entropy energy and matter (upper part of diagram) sustains the economy and drives the circular flows of exchange value (lower part of diagram), yet is invisible to conventional economic analysis.

Box 2: The Blind Spot in Conventional Analysis

Mainstream economics approaches the issue of adequate capital stocks through monetary analysis. However, money and prices are excessively abstracted from the material wealth they are supposed to represent. For example:

Where there are markets for ecologically significant "goods and services," prices do not reflect the size of the corresponding natural capital stocks, whether there are critical minimal levels below which stocks can no longer replenish themselves (the real measure of biophysical scarcity), the functional roles of such stocks in relevant ecosystems, or their ultimate value in sustaining life. Meanwhile...

Many ecological goods and most life-support services remain unpriced and therefore not subject to market signals or related behavioral change of *any* kind. (The ozone layer is a case in point.)

Unfortunately, current efforts to "internalise the externalities," "get the prices right" and otherwise commodify the environment suffer from major data gaps, the functional transparency of natural processes (we don't know they're valuable until they're gone), and other theoretical problems that often render futile attempts to quantify, let alone price, many critical ecological goods and services (Vatn and Bromley 1993). In short: Standard monetary analyses are blind to ecological structure and function and are therefore incapable of indicating either ecologically meaningful scarcity of incipient systems destabilization.

Part of the reason for this perceptual gulf is that many of the questions raised by ecological and thermodynamic considerations are invisible to mainstream approaches. Economic analysis is based on the circular flow of exchange value (money flows) through the economy, not on physical flows and transformations. Prevailing economic models of growth and sustainability thus "lack any representation of the materials, energy sources, physical structures, and time-dependent processes basic to an ecological approach" (Christensen, 1991). Thus while, the second law is arguably the ultimate governor of economic activity, standard models do not recognize the unidirectional and thermodynamically irreversible flux of available energy and matter upon which the economy depends (Figure 1). Similarly, conventional approaches to conservation and sustainability focus mainly on the money values of marketable resource commodities (e.g., timber) and are insensitive to the intangible (but ultimately more valuable) non-market ecological functions of the natural capital that produces them (e.g., the forest ecosystem). Box 2 summarizes this problem.

In this light, economists' lack of concern about carrying capacity would seem to derive, in large part, from conceptual weaknesses in their analytic models. The necessary conditions for ecological sustainability can better be defined through the analysis of physical stocks and flows interpreted in light of appropriate ecological and complex systems theory.

Technology and Trade: No Boon to Carrying Capacity

As previously noted, conventional analysts often argue that trade and technology expand ecological carrying capacity. This is a misconception. Even in the best of circumstances, technological innovation does not increase carrying capacity per se but only the efficiency of resource use. In theory, shifting to more energy- and material-efficient technologies should enable a defined environment to support a given population at a higher material standard, or a higher population at the same material standard, thereby seeming to increase carrying capacity. However, in either case, the best we could hope for in an increasingly open global economy would be to maintain total human load constant in the vicinity of carrying capacity -- the latter would still ultimately be limiting.

In practice, we have not done even this well -- the steady gains in efficiency throughout the post-war period have been accompanied by steadily increasing *per capita* and aggregate consumption. It seems that efficiency gains may actually work *against* conservation through the price and income effects of technological savings. As Saunders (1992) notes, this counter intuitive hypothesis has been the focus of considerable controversy. He tested it using neoclassical growth theory and found that energy efficiency gains might well increase aggregate energy consumption by making energy cheaper and by stimulating economic growth, which further "pulls up" energy use. How might this work? If a firm saves money by switching to more energy- and material efficient manufacturing processes, it will be able to raise wages, increase dividends, or lower prices, which can lead to increased net consumption by workers, shareholders, or consumers respectively. These behavioral responses to changes in prices and income are referred to as the "rebound effects" by economists (Jaccard, 1991). Similarly, technology-induced money savings by individuals are usually redirected to alternative forms of consumption, canceling some or all of the initial potential benefit to the environment (Hannon, 1975). To the extent that such mechanisms contribute to increased aggregate material consumption and accelerated stock depletion, they indirectly *reduce* carrying capacity.

[Rebound effects can be avoided if adequate stock depletion taxes or marketable resource quotas are imposed. (Such incentives should be used to stimulate conservation in the first place.) "Ecological taxation" would raise unit resource prices, effectively capturing any efficiency savings and preventing their further circulation in the economy. However, because of reduced material and energy intensity, consumer prices for goods and services would increase less rapidly than resource prices (Rees, 1994a).]

More generally, however, technology can directly reduce carrying capacity while creating the illusion of increasing it! We often use technology to increase the short-term energy and material flux through exploited ecosystems. This seems to enhance systems productivity while actually permanently eroding the resource base. For example, the effectiveness of electronic fish-finding devices and high-tech catching technology has overwhelmed the reproductive capacity of fish stocks; energy-subsidized intensive agriculture may be more productive than low-input practices in the short term, but it also increases the rate of soil and water depletion. The net effect is to create unsustainable dependencies on enhanced material flows (the technologies involved are often based on nonrenewable resources) while reducing long-term carrying capacity.

The carrying capacity gains from trade are also illusory. While commodity trade may release a local population from carrying capacity constraints in its own home territory, this merely displaces some fraction of that population's environmental load to distant export regions. In effect, local populations import others' "surplus" carrying capacity. The resultant increase in population and resource use in import regions increases the aggregate load of humanity on the ecosphere but there is *no net gain* in carrying capacity since trade reduces the load-bearing capacity of the export regions. Indeed, like technology, trade may even result in reduced global carrying capacity if access to cheap imports (e.g., food) lowers the incentive for people to conserve their own local natural capital stocks (e.g., agricultural land) and leads to the accelerated depletion of natural capital in distant export regions.

These comments are not to be taken as arguments against technology or trade per se. Rather the point is to emphasize that conventional assumptions about both should be carefully reexamined in light of carrying capacity considerations and that certain conditions must be satisfied before either can contribute to ecological sustainability.

APPROPRIATED CARRYING CAPACITY AND ECOLOGICAL FOOTPRINTS

We can now redefine human carrying capacity as the maximum rates of resource harvesting and waste generation (the maximum load) that can be sustained indefinitely without progressively impairing the productivity and functional integrity of relevant ecosystems wherever the latter may be located. The size of the corresponding population would be a function of technological sophistication and mean *per capita* material standards (Rees, 1988). This definition reminds us that regardless of the state of technology, humankind depends on a variety of ecological goods and services provided by nature and that for sustainability, these must be available in increasing quantities from somewhere on the planet as population and mean *per capita* resource consumption increase (see also Overby, 1985).

Now, as noted earlier, a fundamental question for ecological economics is whether supplies of natural capital will be adequate to meet anticipated demand into the next century. Inverting the standard carrying capacity ratio suggests a powerful way to address this critical issue. Rather than asking what population a particular region can support sustainably, the carrying capacity question becomes: How large an area of productive land is needed to sustain a defined population indefinitely, *wherever on Earth that land is located?* (Rees, 1992; Rees & Wackernagel, 1994; Wackernagel & Rees, 1995). Since many forms of natural income (resource and service flows) are produced by terrestrial ecosystems and associated water bodies, it should be possible to estimate the area of land/water required to produce sustainably the quantity of any resource or ecological service used by a defined population at a given level of technology. The sum of such calculations for all significant categories of consumption would give us a conservative area-based estimate of the natural capital requirements for that population.

A simple mental exercise serves to illustrate the ecological reality behind this approach. Imagine what would happen to any modern human settlement or urban region, as defined by its political boundaries or the area of built-up land, if it were enclosed in a glass or plastic hemisphere completely closed to material flows. Clearly the city would cease to function and its inhabitants would perish within a few days. The population and economy contained by the capsule would have been cut off from both vital resources and essential waste sinks leaving it to starve and suffocate at the same time. In other words, the ecosystems contained within our imaginary human terrarium would have insufficient carrying capacity to service the ecological load imposed by the contained population.

This mental model illustrates the simple fact is that as a result of high population densities, the enormous increase in *per capita* energy and material consumption made possible by (and required by) technology, and universally increasing dependencies on trade, *the ecological locations of human settlements no longer coincide with their geographic locations.* Twentieth century cities and industrial regions are dependent for survival and growth on a vast and increasingly global hinterland of ecologically productive landscapes. It seems that in purely ecological terms, modern settlements have become the human equivalent of cattle feedlots!

Cities necessarily appropriate the ecological output and life support functions of distant regions all over the world through commercial trade and the natural biogeochemical cycles of energy and material. Indeed, the annual flows of natural income required by any defined population can be called its "appropriated carrying capacity. Since for every material flow there must be a corresponding land/ecosystem source or sink, the total area of land/water required to sustain these flows on a continuous basis is the true "ecological footprint" of the referent population on the Earth. (See Box 3 for definitions of these and related indicators.) Calculating its ecological footprint provides a rough measure of the natural capital requirements of any subject population for comparison with available supply.

"Footprinting" the Human Economy

Box 3: A Family of Area-based Sustainability Indicators

Appropriated Carrying Capacity - The biophysical resource flows and waste assimilation capacity appropriated per unit time from global totals by a defined economy or population.

Ecological Footprint - The corresponding area of productive land and aquatic ecosystems required to produce the resources used, and to assimilate the wastes produced, by a defined population at a specified material standard of living, wherever on Earth that land may be located.

Personal planetoid - The per capita ecological footprint (EF_p/N).

Fair Earthshare - the amount of ecologically productive land "available" per capita on Earth, currently about 1.5 hectares (1995). A fair seashare (ecologically productive ocean - coastal shelves upwellings and esturaries - divided by total population) is just over .5 ha.

Ecological Deficit - The level of resource consumption and waste discharge by a defined economy or population in excess of locally/regionally sustainable natural production and assimilative capacity (also, in spatial terms, the difference between that economy/population's ecological footprint and the georgraphic area it actually occupies)

Sustainability Gap - A measure of the decrease in consumption (or the increase in material and economic efficiency) required to eliminate the ecological deficit. (Can be applied on a regional or global scale.)

The first step in calculating the ecological footprint of a study population is to estimate the *per capita* land area appropriated (aa) for the production of each major consumption item 'i.' We do this by dividing average annual consumption of that item ['c,' in kg/capital] by its average annual productivity or yield ['p,' in kg/ha] per hectare:

$aa_i = c_i/p_i$

In practice, it is often only possible to estimate average *per capita* consumption by dividing aggregate consumption by the referent population size. Of course, many consumption items (e.g., clothing and furniture) embody several inputs and we have found it useful to estimate the a areas appropriated by each significant input separately. Ecological footprint calculations are therefore both more complicated and more interesting than appears from the basic concept. So far we have estimated the land requirements to produce 23 categories of consumer goods and services (Wackernagel & Rees, 1995).

We then compute the total *per capita* ecological footprint ('ef') by summing all the ecosystem areas appropriated by individual items in the annual shopping basket of consumption goods and services:

$$ef = \sum_{i=1}^{i=n} aa_i$$

Thus, the ecological footprint (EF_p) of a study population is the *per capita* footprint multiplied by population size (N): $EF_p = N(ef)$

We account for direct fossil energy consumption and the energy content of consumption items by estimating the area of carbon-sink forest that would be required to sequester the carbon dioxide emissions associated with burning fossil fuels ([carbon emissions/capital/[assimilation rate/hectare]), on the assumption that atmospheric stability is central to sustainability. (An alternative is to estimate the area of land required to produce the biomass energy equivalent [ethanol] of fossil energy consumption. This produces a larger energy footprint than the carbon assimilation method.)

Every effort is made to avoid double-counting in the case of multiple land uses and where there are data problems or significant uncertainty we err on the side of caution. Also, while we define the footprint comprehensively to include the land/water areas required for waste assimilation, our calculations to date do not account for waste emissions other than carbon dioxide. Accounting fully for this ecological function would add considerably to the ecosystem area appropriated by economic activity. Together these factors suggest that our ecological footprint calculations to date are more likely to be under-estimates than over-estimates.

Data from my home city, Vancouver, British Columbia, Canada, serve to illustrate application of the concept. Vancouver proper has a population (1991) of 472,000 and an area of 114 km^2 (11,400 hectares). However, the average Canadian requires over a hectare (ha) of crop and grazing land under current land management practices to produce his/her high meat protein diet and about .6 ha for wood and paper associated with various other consumption items. In addition, each "occupies" about .2 ha of ecologically degraded and built-over (e.g., urban) land. Canadians are also among the world's highest fossil energy consumers with an annual carbon emission rate of 4.2 tonnes carbon (15.4 tonnes CO2) *per capita* (data corrected for carbon content of trade goods). Therefore, at a carbon sequestering rate of 1.8 tonnes/ha/yr an additional 2.3 ha of middle-aged North temperate forest would be required as a continuous carbon sink to assimilate the average Canadian's carbon emissions (assuming the need to stabilize atmospheric carbon dioxide levels).

Considering only these data, the terrestrial "personal planetoid" of a typical Vancouverite approaches 4.2 ha, or almost three times his/her "fair Earthshare." [An additional .74 ha of continental shelf "seascape" is appropriated to produce the average Canadian's annual consumption of 24kg of fish.] On this basis, the 472,000 people living in Vancouver require, conservatively, 2.0 million ha of land for their exclusive use to maintain their current consumption patterns (assuming such land is being managed sustainably). However, the area of the city is only about 11,400 ha.

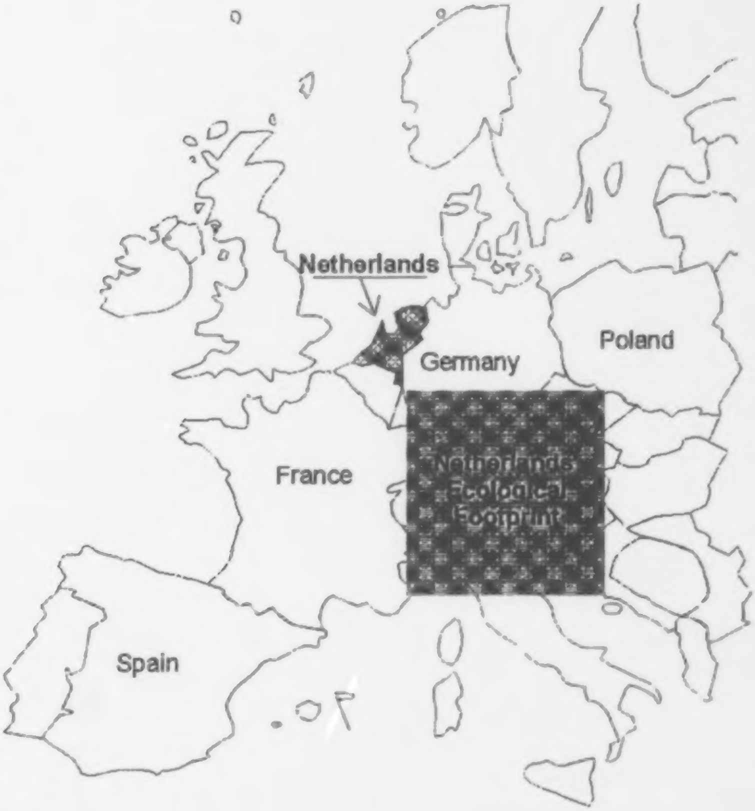
This means that the city population appropriates the productive output of a land area nearly 174 times larger than its political area to support its present consumer lifestyles. [The Vancouver Regional District (metropolitan area), with 1.6 million inhabitants and a land-base of 2930 km^2, has an ecological footprint of 6,720,000 ha, 23 times its geographic area.] While this result might seem extraordinary, other researchers have obtained similar results. Folke et al. (1994) report that the aggregate consumption of wood, paper, fiber, and food (including seafood) by the inhabitants of 29 cities in the Baltic Sea drainage basin appropriates an ecosystem area 200 times larger that the area of the cities themselves. (The latter study does not include energy land.)

Many whole developed countries have a similar overwhelming dependence on external eco-productivity. The Netherlands (area: 33,920 sq km) serves to illustrate: We estimate that the people of Holland require a land area more than 14 to 15 times larger than their country to support current domestic consumption of food, forest products, and energy (Figure 2) (Rees & Wackernagel, 1994). The food footprint alone is more than 100,000 square kilometers, based on world average productivities. Indeed, Dutch government data suggest that the Netherlands appropriates 100,000 to 140,000 km^2 of agricultural land, mostly from the third world, for food production (including value-added food products produced in the Netherlands for export) (RIVM, 1991, cited in Meadows et al. 1992). [Most of the imported "food" is fodder for domestic livestock. This is a sufficient "Second Law" explanation of the fact that animal manure represents one of the most pressing waste disposal problems confronting the Netherlands!] This "imported" land is five to seven times the area of Holland's domestic arable land.

It is worth remembering that the Netherlands, like Japan, is often held up as an economic success story and an example for the developing world to follow. Despite small size, few natural resources, and relatively large populations, both Holland and Japan enjoy high material standards and positive current account and trade balances as measured in monetary terms. However, our analysis of physical flows shows that these and most other so-called "advanced" economies are running massive, unaccounted, ecological deficits with the rest of the planet (Table 1). The last two columns in Table 1 represent low estimates of these *per capita* ecological deficits in a selection of developed countries. Even if their land were twice as productive as world averages, many European countries would still run a deficit more than three times larger than domestic natural income.

These data emphasize that all the countries listed, except for Canada, are over-populated in ecological terms -- they could not sustain themselves at current material standards if forced by changing circumstances to live on their remaining endowments of domestic natural capital. This is hardly a good model for the rest of the world to follow.

FIGURE2. The Ecological Footprint of the Netherlands



With an area of 33,920 square kilometers and a human population density of 440/km², the Netherlands depends on the ecological productivity (carrying capacity) of an area almost 15 times larger than the entire country.

Canada (large area, resource rich, small population) is one of the few developed countries that consumes less than its natural income domestically. However, Canada's natural capital stocks are being depleted by exports of energy, forest, fisheries, agricultural products, etc. In short, Canada's apparent ecological surpluses are being incorporated in part by trade into the ecological footprints -- and deficits -- of other countries, particularly those of the United States and Japan.

Sustaining Development with Phantom Planets?

	Ecologically Productive Land (In Hectares)	Population (1995)	Ecologically Productive Land *Per Capita* (In Hectares)	National Ecological Deficit *Per Capita*	
				(In Hectares)	(In % Available)
Country	a	b	c = a/b	d = Footpr.-c	e = d/c
Countries with 2-3 ha Footprints				*Assuming a 2 Hectare Footprint*	
Japan	30,340,000	125,000,000	0.24	1.76	730%
Korea	8,669,000	45,000,000	0.19	1.81	950%
Countries with 3-4 ha Footprints				*Assuming a 3 Hectare Footprint*	
Austria	6,740,000	7,900,000	0.85	2.15	250%
Belgium	1,987,000	10,000,000	0.20	2.80	1,400%
Denmark	3,270,000	5,200,000	0.62	2.38	380%
France	45,385,000	57,800,000	0.78	2.22	280%
Germany	27,734,000	81,300,000	0.34	2.66	780%
Netherlands	2,300,000	15,500,000	0.15	2.85	1,900%
Switzerland	3,073,000	7,000,000	0.44	2.56	580%
Countries with 4-5 ha Footprints				*Assuming 4.3 (Can) and 5.1 (US) Hectare*	
Canada	433,000,000	28,500,000	15.19	(10.89)	(250%)
United States	725,643,000	258,000,000	2.81	2.28	80%

Ecological deficits are a measure of the entropic load and resultant "disordering" being imposed on the ecosphere by so-called advanced countries as the unaccounted cost of maintaining and further expanding their wealthy consumer economies. This massive entropic imbalance invokes what might be called the first axiom of ecological footprint analysis: On a finite planet, not all countries or regions can be net importers of carrying capacity. This, in turn, has serious implications for global development trends.
The current objective of international development is to raise the developing world to present first world material standards. To achieve this objective, the Brundtland Commission argued for "more rapid economic growth in both industrial and developing countries" and suggested that "a five to ten fold increase in world industrial output can be anticipated by the time world population stabilizes some time in the next century" (WCED, 1987).

Let us examine this prospect using ecological footprint analysis. If just the present world population of 5.8 billion people were to live at current North American ecological standards (say 4.5 ha/person), a reasonable first approximation of the total productive land requirement would be 26 billion ha (assuming present technology). However, there are only just over 13 billion ha of land on Earth, of which only 8.8 billion are ecologically productive cropland, pasture, or forest (1.5 ha/person). In short, we would need an additional two planet Earths to accommodate the increased ecological load of people alive today. If the population were to stabilize at between 10 and 11 billion sometime in the next century, five additional Earths would be needed, all else being equal – and this just to maintain the present rate of ecological decline (Rees & Wackernagel, 1994).

While this may seem to be an astonishing result, empirical evidence suggests that five phantom planets is, in fact, a considerable underestimate (keep in mind that our footprint estimates are conservative). Global and regional-scale ecological change in the form of atmospheric change, ozone depletion, soil loss, ground water depletion, deforestation, fisheries collapse, loss of biodiversity, etc., is accelerating. This is direct evidence that aggregate consumption exceeds natural income in certain critical categories and that the carrying capacity of this one Earth is being steadily eroded. [We should remember Liebigs "Law of the Minimum" in this context. The productivity and ultimately the survival of any complex system dependent on numerous essential inputs or sinks is limited by that single variable in least supply.] In short, the ecological footprint of the present world population/ economy already exceeds the total productive area (or ecological space) available on Earth.

This situation is, of course, largely attributable to consumption by that wealthy quarter of the world's population who use 75% of global resources. The WCED's "five- to ten-fold increase in industrial output" was deemed necessary to address this obvious inequity while accommodating a much larger population. However, since the world is already ecologically full, sustainable growth on this scale using present technology would require at [least] five to ten additional planets.

ADDRESSING THE DOUBLE-BIND OF SUSTAINABILITY

Humankind now seems to be the victim of a global "catch-22" of its own making. More material growth, at least in the poor countries, seems essential for socioeconomic sustainability, yet any global increase in material throughput is ecologically unsustainable. What does ecological footprint analysis have to say about this double bind and how we might get out of it? One can draw several conclusions from the above analysis that address one or both sides of the dilemma:

- The wealthy already consume on average three times their fair share of sustainable global output. Since additional material growth in rich countries would appropriate additional carrying capacity further reducing the ecological space available to poor countries, it is both ecologically dangerous and morally questionable. To the extent we can create room for growth, it should be allocated to the third world.

- Confidence in the ability of unregulated trade and technology to overcome ecological limits on material growth cannot be justified. Indeed, it is arguable that under prevailing assumptions, expanding trade and dominant technologies are allowing humanity dangerously to overshoot long-term global carrying capacity.

- Trade has been a major contributor to increasing gross world product in recent years. However: a) trade is one of the mechanisms by which the rich appropriate carrying capacity and increase their own ecological footprints, and b) to the extent that trade increases total human load on the ecosphere and accelerates the depletion of natural capital, it reduces the ecological safety net for all and brings us closer to global limits. Global terms of trade must therefore be reexamined to ensure that it is equitable, socially constructive, and confined to true ecological surpluses. At the very least/ prices must reflect ecological externalities and the benefits of growth from trade should flow to those who need them most (see Rees, 1 994b).

- On a finite planet, ecological trade is a zero-sum game -- there can be no net importation of carrying capacity for the world as a whole. Ecological footprint analysis provides a useful tool for the development of regional ecological (i.e., physical) accounts. These would assist countries tries or (bio-) regions to compute their true ecological loads on the ecosphere and to monitor their ecological/thermodynamic trade balances. Such accounts would also enable the world community to ensure that aggregate global flows do not exceed sustainable natural income (global carrying capacity).

- Urbanization, globalization, and trade all reduce the negative feedback on local populations from unsustainable land and resource management practices. (For example, trade enables us to discount the value of local natural capital and blinds us to the negative consequences of our over-consumption which often accrue in distant export regions.) This provides a further argument to shift the emphasis in development from global economic integration and inter-regional dependency toward intra-regional ecological balance and relative self-reliance. (If all regions were in ecological steady-state the aggregate effect would be global stability.) This position is compatible with Daly's and Goodland's (1993) recommended alternative "default position" on international trade, that we should strive "to reduce rather than increase the entanglement between nations."

- Ecological footprint analysis supports the argument that to be sustainable, economic growth must be much less material and energy intensive than at present (see, for example, Pearce, 1994). It therefore supports the case for ecological tax reform in aid of resource conservation (von Weizsacker, 1994). For example, depletion taxes and marketable quotas on natural capital inputs to the economy would: a) stimulate the search for more materially and energy efficient technologies; b) preempt any resultant cost savings, thereby preventing the economic benefits of efficiency gains from being redirected to additional or alternative forms of consumption, and; c) generate an investment fund that could be used to rehabilitate important forms of self-producing natural capital (Rees, 1 994a).
- Ecological footprint analysis provides a measure of both individual countries' ecological deficits and the global sustainability gap (Box 3). The latter in particular is a measure of the extent to which the human economy must be dematerialized in order to fit within global carrying capacity. The present and related analyses confirm that a "factor-10" reduction in the material and energy intensity per unit of economic service, as suggested by researchers at the Wuppertal Institute in Germany (Schmidt-Bleak, 1993a;b), is a reasonable if daunting goal. ["Reasonable" because a reduction in throughput of this magnitude seems necessary, "daunting" because a reduction of this magnitude through material efficiency alone seems impossible, at least within in the next few decades. Sustainability may require that competitive individualism and the consumer lifestyle give way to cooperative mutualism and an economy of sufficiency.]

CONCLUSION

Appropriated carrying capacity and ecological footprint analysis provide several informative area-based indicators of sustainability. Unfortunately, these same indicators reveal that we are presently falling distressingly short of achieving that elusive goal. Such findings do not, however, support a counsel of despair. Rather, ecological footprint analysis raises a cautionary signal, suggests a variety of concrete sustainability guidelines, and supports a broadly-based program of reforms that could redirect us in the direction we all seem to want to go. In short, to the extent that the assumptions and prescriptions of this approach are a better reflection of material reality that those of mainstream models, the present analysis is a good news story. The bad news is that most of the world seems committed as never before to the well-worn expansionist path. ✪

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SPEAKER PROFILE

William Rees received his PhD in bio-ecology from the University of Toronto. He has taught at the University of British Columbia since 1969-70 and is currently Professor and Director of the university's School of Community and Regional Planning.

For two decades, Dr Rees' teaching and research has focused on the public policy implications of global environmental trends and on the necessary ecological conditions for sustainable development. Much of his recent work is in the realm of ecological economics and human carrying capacity. He developed the "ecological footprint" concept, a new analytic tool which provides land-based indicators of economic (un)sustainability, and in 1995 published Our Ecological Footprint: Reducing Human Impact on Earth (co-authored with former PhD student Mathis Wackernagel). Professor Rees has long promoted the idea that because up to 75% of global resource consumption and waste generation occurs in large settlements, it is in cities, urban values, and urban development policy that we may find the greatest leverage in our efforts to achieve global sustainability. He has taught or lectured on these topics across Canada as well as in Australia, Austria, China, Germany, Great Britain, Norway, Indonesia, Korea, the former Soviet Union, Sweden, and the USA.

THE SEVEN DEADLY THREATS TO ORGANIC INTEGRITY

— PATRICK HOLDEN —

This presentation is a reprint from an article written by Patrick Holden, which was published in 'Living Earth', the magazine of the Soil Association in the UK.

The organic market may be growing by at least 50% each year, but I believe that at this time of unprecedented growth the organic market is uniquely vulnerable to what I have called here the seven deadly threats to organic integrity.

Collectively they could threaten the dynamic growth of the market by undermining consumer confidence in organic products.

Let us look at those threats:

1. Certification wars

This danger stems from John Gummer's concept of the 'certification market place', when he set up the UK Register of Organic Food Standards (UKROFS) in 1987. On the crest of the Thatcherite wave, the then minister of agriculture argued for no limit to the number of organic certifiers, to ensure efficiency and competitiveness.

But the danger of a certification marketplace, apart from the risk of consumer confusion over organic logos, is that producers and processors shop around for the lowest priced certification (possibly with less rigorous inspection procedures) and the lowest standards of production.

This has already happened in the UK egg market and is beginning to happen with organic pork. The reason why so many organic poultry and pork products do not carry the Soil Association symbol is because they are produced to lower standards, often abroad, and therefore sell for less.

2. Price wars

Such battles are based on the myth that, by using a mixture of standards dilution, price pressure on producers, margin cutting and 'efficiencies in the processing chain', it is possible to sell organic foods as cheaply as their conventional counterparts. Often imported products will be preferred because of lower labour costs. This subject is debated elsewhere in this issue, but lets be clear about this – it will end in tears. The real battle should be to re-educate consumers that it actually costs more to produce food with integrity.

3. Compromises on food quality

The essence of this complex theme relates to the food industry belief that it can simply substitute organic raw materials for conventional and carry on processing as before. In doing so it forgets consumers buy organic food because of a higher quality.

Despite the contrary views of the Food Standards Agency, most consumers are convinced that organic foods contain fewer undesirable ingredients, has more primary and secondary nutrients, and is in some way more vital and healthy. Any attempt by the food industry to compromise the integrity of organic food by adulteration, the wrong kind of processing, or any other cheap and cheerful shortcut, is certain to undermine the consumer confidence in the quality and value of what they are buying. The Soil Association is working on a report bringing together for the first time all the research evidence into the field of food quality.

4. Agricultural establishment ignorance

Some senior policy makers in the farming industry, including at the National farmers Union and other bastions of the agricultural establishment still see organic food as forever a niche market, and organic farming as a good diversification option for zealots offering expensive food to a middle class minority, which will never catch on in a big way. Their thinking could hinder government policy encouraging increased conversion to organic production, thereby starving the market of the raw materials, as it needs for its sustainable development.

5. The Food Standards Agency

A classic example of wrong government thinking. The FSA, established in response to public concerns about pesticide residues, bacteria contaminating food, genetic engineering, and declining food quality, has ended up treating the symptoms not the causes of the agricultural malaise. Armies of hygiene police acting on the 'sterilize it and it's safe' principle only perpetuate the problem of British agriculture. Unfortunately neither Sir John Krebs nor most of his senior colleges in the FSA seem to understand that health is not the absence of disease but rather a state of vital equilibrium between a living organism and its environment, resulting fro sound management, and especially sound nutrition.

6. Own label products

What matters most with organic food is that the label tells the 'story' behind the product. Most of us thirst to know about the person, farm production system, region and links in the food chain behind the products. Is the Soil Association implacably against own label products? Of course we are not, but with the notable exception of whine, many own label products do a very good job of obscuring the origins of the product, and divorcing the consumer from the producer, and possibly undermining their enthusiasm to buy organic. This is not a popular position to take with supermarkets, but I believe it needs to be said.

7. Consumer ignorance

This is the greatest enemy of all. I recently heard that only seven per cent of consumers are buying 58 per cent of all organic food sold in the UK. What separates this group from occasional consumers or the unconverted? Although income is of course a factor, the answer is awareness. No market can prosper without consumer knowing why they purchase a product.

I believe that one reason why the UK organic food market is stronger than any in mainland Europe is because of the work of the Soil Association in building consumer awareness.

By bringing together producer, processor, retailer and consumer under one organizational umbrella, we have gained much credibility with the media as an authoritative source of accurate information about all food and farming issues. Through them we convey the value of purchasing organic food to millions of consumers. However, we must guard against complacency in this area. Without a commitment to increasing public awareness of the links between sound organic soil management and healthy plants, animals, people and the environment, the market will not reach its potential.

The greatness of that potential depends on our ability to counter these seven deadly threats. Those who have nurtured the growth of the organic movement must be ever vigilant that, like so many radical movements, it does not, as a direct result of its success, become its opposite. If we successfully resist these threats we could transform our food culture and build a future where the majority of UK farmland is under organic management with corresponding availability of organic foods in the market place.

SPEAKER PROFILE

The Soil Association is a membership charity which has been researching and promoting organic farming as the key to sustainable agriculture since 1946. It is the UK's leading campaigning organization and certification body for organic food and farming. It campaigns against issues like GMOs in food and the routine use of antibiotics in conventional farming.

A comprehensive information and education service is available for both consumers and producers alike, through publications, leaflets and an annual program of events.

Patrick Holden is its Executive Director.

THE NEED FOR AN EFFICIENT REGULATORY SYSTEM FOR ORGANIC PRODUCTION IN CANADA

— DARRYL AMEY —

This presentation focuses on the need I see for a strong, consistent regulatory system for organic food production in Canada.

I am not promoting any particular system, nor am I representing any organization. The opinions I express are my own and I am certainly not here to oppose any efforts that are now in progress.

There will be more questions than answers in what I have to say, and I hope it will be an introduction to a very production discussion.

I also hope that an ongoing process, to address regulatory issues, will evolve from what is achieved at this conference.

To start, I think we have to consider why we are involved in organic food production. Are we trying to build a food system that protects the environment, fairly compensates all those involved for their contribution, and provides consumers with good nutrition and good value for their food dollar? Do we believe what we are doing is making the work a better place to live?

Are we a bunch of small groups, each pursuing its own self interests, or are we a strong, united movement focused on changing the way food is produced in the world?

Society is coming to terms with the fact that we cannot continue to devastate the planet with our current agricultural practices. Environmentally-friendly and sustainable systems producing food that is free of genetically-altered material, growth hormones and antibiotics, is the agriculture of the future.

Organic producers are leading the way in developing more sustainable agriculture. The opportunities we have to create real alternatives in food production are tremendous, but if we are to take advantage of these opportunities, and be seen as leaders, we must be creditable.

To be creditable, our production methods must be clearly defined and our standards recognized, and the uniqueness of what we produce clearly understood. The integrity of the product must be protected from the field to the store shelf so the consumer can be confident the product is indeed what we claim it to be.

I also believe that to be creditable we must have the capability to provide training programs for newcomers to organic agriculture, so they understand

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the philosophy and recognize what is required to be an organic producer. This is particularly important now when the industry is growing so rapidly.

Many of the co-operative certification systems have this education component as an integral part of their programs. These membership organizations become the community which provides support and information for their members.

In my opinion, the organic farmers have done a creditable job of creating regulatory systems at the primary production level. Many of these regional grassroots movements have developed excellent certification systems that are particularly suited to serve local markets.

Today, organic products are produced in larger volumes and move much farther. Here in Saskatchewan where large acreages of organic crops are grown for export, direct contact between producer and consumer is much less common than in areas where the bulk of organic production goes into a local market.

It is here where we can see that having all certifications for products moving into larger and more distant markets fall under a common ISO Guide 65 compatible standard. This would eliminate the need for many producers to have multiple certifications to gain access to markets and it would certainly reduce the paperwork for traders and processors who must source and combine products from various producers.

A product certified by a recognized certification organization leaving the farmgate today is backed by a verifiable certification process. The trader purchasing the product is also most likely certified, but the processor may or may not be; the distributor of the processed product probably is not certified; and the retailer moving the product to the consumer would rarely be certified. This is where the integrity of the product becomes compromised as it moves into the processing and distribution system.

One of the most obvious examples of a broken audit trail is a health food store putting unidentified product in bulk bins. When a handler of organic products is not a member of a recognized certification system, there is no checking mechanism in place to verify that the product is certified or has been grown to organic standards.

This is why I believe all levels of the system that produces and moves certified organic products to the consumer must be brought under a common regulatory structure.

In my opinion, anyone in Canada who wishes to label their product certified organic, regardless of the certification organization they choose, should be required to meet or exceed the minimum requirements of the Canadian Standard for Organic Agriculture. Any product imported into Canada and labeled certified organic would be required to meet the same standard.

This would place everyone on a level-playing field and provide the consumer with meaningful and creditable labeling.

I believe we have reached a point in the evolution of organic agriculture where all certification systems in Canada should be moving toward working under one common production standard. The development of the National Standard is the first step in achieving this goal.

As I have said, very creditable regulatory systems have been developed by players in the organic food system, but they have often failed to bring all the players into the system.

Now we have to decide if we are going to continue to regulate our own industry or will we hand this over to someone like the Canadian Food Inspection Agency or some branch of Agriculture Canada.

I don't often get much discussion on this subject. People are usually quite adamant that the industry must be self-regulated, and I understand that this is the way the government would prefer it.

Another option would be to allow a group of professional certifiers to provide certification on a fee-for-service basis. This concept is not well received by many organic producers. It is seen as contrary to the basic philosophy of a farm system being able to provide its needs internally. Many see purchasing certification from an outside system little different than depending on the use of off-farm inputs.

Fee-for-service systems do not have members and don't create the community to provide support and facilitate the movement of information among producers.

To create a self-regulating structure under the Standards Council of Canada, we would have to form an association that would represent all the players involved in the production and handling of organic foods. This would include retailers who are packaging and labeling products.

This is where we seem to run into a little difficulty. We seem to have a problem with the organizations we create. Once they are established, we tend to stop seeing them as our creation and start to distrust their motives. Then we pull out because our interests are not being addressed as we had hoped, or we believe the interest of someone else is being given priority.

This is where we must look past narrow self-interests and focus on what the organization can achieve in terms of meeting some very important needs of the organic movement.

This organization can do many things as well as implement the standard and unify the industry. One of the most important things it must do is create a structure to revise and update the National Standard. It could also be the voice of the Canadian organic food system in the international arena.

No less important would be its role in the promotion of the organic movement and in raising public awareness of food, health and environmental issues.

One of the advantages of an all-inclusive structure is that it can be cost effective by having the costs borne by all the players involved in the system.

To wrap up, I will run through the questions I believe we have to find answers to if we are to create an efficient framework for the organic food system to work within:

- Do we actually have a vision for a better food system?
- Is there a common philosophy shared by participants in the organic movement?
- Where do we find the common ground from which to work?
- Do we have the desire or the ability to be a self-regulating industry?
- What are the alternatives to self-regulation?
- How will the national standards to maintained and revised as the system evolves?
- Should primary producers and processors be expected to bear the cost of regulating a food system that involves many other players and benefits society as a whole?
- Who speaks for the players in the Canadian organic food system in the international arena? ✪

SPEAKER PROFILE

Darryl Amey *received training as heavy equipment mechanic. He worked in this trade in different parts of Canada, in Africa and Australia before he started his own agricultural equipment repair business on the farm in Radisson, Saskatchewan. Mr. Amey started farming full time in 1989 and had his farm certified organic in 1990. Today he operates a small scale, on-farm, processing business and sells high quality health food from field crops directly to consumers and health food outlets.*

He is actively involved in his local chapter of the Organic Crop Improvement Association (OCIA) and President of the Saskatchewan Organic Directorate (SOD). Mr. Amey is actively working on different levels towards a food system in which farmers regain more control over their farms and supply more consumers in their own region with safe and highly nutritious food at reasonable prices.

DOES ORGANIC PRODUCTION PROVIDE FOR A MORE HEALTHY FOOD THAN NON-ORGANIC PRODUCTION?

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Report on a Dutch study, with some additional comments.

Outline of the paper

In this paper I will mainly report on an extensive desk study and expert consultation by van Vliet (1998). It was the first report on the delicate issue of health effects of organic food consumption wherein expert workshops involving representatives of institutions were involved at such a scale. The idea was to find out in how much the evidence already available in literature did meet the standards of institutional science, so as to legitimate recommendations to the institutional research and advisory policy.

The report as such is a 29 pages summary of the whole study, which has two lengthy appendixes:

1) a working document on the expert consultations and

2) a thorough discussion of some 2000 references in literature.

It was financed by the Science Shop Foundation (SSF) of the Wageningen Agricultural University, in a co-operation of the mentioned Science Shop, the Department of Ecological Agriculture (DEA) and the Dutch Platform for Biological Agriculture and Nutrition (PBAN), co-ordinated by Prof. Goewie, chair of the DEA. Hobbelink (SSF, chairing), Dagnelie from the Epidemiology Department of Maastricht University, Huber from the Dunamis Nutrition Institute in Driebergen and the author (Wageningen Agricultural University) served on the study's supervising committee. Furthermore, 15 experts from various institutions related to nutrition figured in the resonance council of the study; 6 of them were familiar with organic agriculture. My paper will first provide for an English summary of the mentioned Dutch report (here referred to as Van Vliet 1998). In the second and last part of the paper I will present some personal points of view in a scheme of a hypothetical nature.

Introduction

Among the main reasons for consumers to buy food from organic production are the positive perceptions of its health, its taste, its respect for animal welfare and for a fair economy. Health primarily in the sense that eating organic products supports the personal or family health, but then also in the sense that the production of organic food does not has negative effects on the environment nor on animal welfare and nature at large (De Wit, 2000). As for taste, together with the European top cooks (Geier, Haest, Pons 1991), many consumers like the overall quality of the organic products as having good organoleptical features (structure, smell and taste), a view shared by the Slow Food Foundation (www.slowfood.com). However, clear scientific evidence of the health effects in humans of eating food purely or mainly from organic production is not yet available. On the other hand, quite a number of incidental researches, for example on health effects in animal feeding, on quality of fresh products using qualitative research methods and case studies, claim that there are clear indications pointing toward a positive effect on human health.

That is why the PBAN asked for a scientific review on the exiting literature, preferable leading to an advice to the institutions for further research.

Materials and Methods

At first, nutrition, food, health and organic production were defined as follows.
Nutrition was used to indicate the products the average consumer daily eats, either fresh or somehow processed. *Food* was taken as indicating the composition of the daily meals. *Health* was taken in conformity with the World Health Organisation (WHO) as a situation of full physical, psychological and social welfare, thus indicating more then only the absence of diseases as for instance caused by toxic substances or microbes.
Organic production was taken as food production complying with the EU standards 2091/92. In line with for example the IFOAM standards, the products form organic agriculture where supposed fully to comply with the *food* standards of Good Agricultural Practice (Codex Alimentarius), to which the *food production* standards of organic production were seen as an additional set of requirements.

Based on these considerations the key question of the desk study was: is there any clear scientific overall evidence that eating organic food instead of non-organic food makes a (positive) difference for the health of the consumers?
The desk study itself was done using the Agralin literature retrieval system, with additional input from an Internet discussion platform and consultation from expert networks. The results obtained from literature were then discussed in the committee and, on a lower frequency, in workshops with the resonance council. On specific question the experts of the council were interviewed individually, each according to their expert knowledge.

Results

Epidemiological studies

To prove health effects of organic food consumption, epidemiological studies would be preferable because, provided their scientific soundness, they would provide for clear evidence, making the point as direct as possible. However, already in an early stage the study, it became clear that results from such studies were not available. Neither comparisons of populations' health, cohort or intervention researches were found. Only some case studies indicating that babies recover form allergies when shifting to organic food.

In the context of social relevance, the study recommends case control and cohort studies on the effects of organic food consumption in cases such as food allergy and intolerance in children, chronic-headache and or chronic-tiredness, digestive problems and cancer. Lengthy discussion were made on the problem of comparing populations eating organic and non-organic food, as the point was made whether in such cases (only) the organic food consumption or (also) a more healthy life style would be compared. Separation of those factors would demand involving very large populations, and thus increase the high costs of such human population studies even more. But then also dietary and cooking issues came up, such as eating more or less meat, more or less vegetables, more or less fresh products, long or short time cooking, deep-freezing and magnetic field heating.

Here, the art of balancing single or multiple factor thinking with systems or holistic thinking came up very clearly, an issue that would penetrate all discussions made in the subsequent workshops of this study.

Animal feeding experiments

As a next-best option for clarity, animal feeding experiments were screened, using the animal as a model for human. Although the value of animals to stand for humans can be discussed in principle, the link may still be rather obvious at large, especially when mammals are used, as in pharmacology and medicine. Indeed, results from several experiments on animal feeding where found. They were largely made in the 1980s, and reported on increases of fertility, survival of new-borns, stress resistance, and growth in cattle, small mammals and chickens when fed on organic food. But these reports were rather small in number and each from them had flaws that, from a strict scientific point of view, made them all fail to convince the expert workshops. Nevertheless the experts agreed that the experiments gave sufficient evidence to legitimate a thorough and large-scale animal feeding experiment, using parameters on several levels (chemistry, biochemistry, physiology and animal behaviour). Though research costs here might be less then those from epidemiology, they still are quite considerable, as they should cover several treatments, parameters and several generations of the animals.

Plant production experiments and analytical research on the products

As plant production experiments and analytical research on the products is relatively least expensive, this approach was found in most papers published. The study argued that their results still provide evidence for the question on health effects, in particular when the presence of positive nutrients or the absence of pollutants or toxins was involved. Most papers were found to report on the quality of products, assessed by chemical and biochemical methods, by looking for storage quality (physiological) or biofoton-radiation, or holistic methods as crystallisation and crop-phenotype development. The products analysed were taken from various places in the food chain (sampling in shops, at wholesalers or on farms) or grown in comparative research set-ups. The focus of the researches varied from screening on the presence of toxic substances (negative quality assessment) to screening for positive features such as vitamins, high quality proteins, essential amino acids, micro-nutrients, dry matter content, structure and constitution (as revealed form lower vulnerability to diseases and stresses) or vitality.

Organic products: less negative and more positive features!?

In many of these cases the products from organic agriculture showed a better quality: less negative and more positive features. However, here again, many details of the researches can be criticized. Variety of the species, sowing and harvesting times (and harvesting phases), soil and climate conditions on the farms, manuring and pre-crop conditions but also storage and transport are among the variables that should be carefully considered. When for example the product are taken from organic and non-organic farms in favourable and unfavourable production sites, and when the non-organic farm produces in an environmentally friendly way, the organic products from the unfavourable area may have less quality then that from the non-organic farm in the favourable area. Like before, here again a key problem is the number of differences that are crucial to contrast the organic versus the non-organic production system, and on the other hand the need for comparability of the results. The first asks for a high number of differences, as organic agriculture is not so much about leaving out or adding any particular treatment: it is a production system in its own right and requires a compatible research approach. In the end it requires a systems understanding in the experts dealing with the research, in experimenting as well as in evaluation. Although here as before, a general statement on positive health effects of organic produce could not yet be made, the expert workshops shared the overall impression that there is ample evidence to legitimate serious interdisciplinary research on the issue.

No reports completely convincing for all

Now as there were no reports found that as such were completely convincing for all experts, an effort was made to make a meta-analyses of all results from organic products' (bio)-chemical analysis. Although much larger in numbers than experiments on animal feeding, the product analyses experiments reported on varied too much in research questions, experimental set-up and parameters used. They could for example have different soils, pre-crops or other growing conditions or used different varieties, different harvesting times etc. Moreover, they often had data on too small populations or lacked statistic elaboration of the experimental data.

The problem of comparing different productions systems

These findings lead to serious discussions in the expert workshops on the problem of comparing different productions systems (organic vs. non-organic) and then still having sufficient similarity to allow comparison in the way scientists are used to. Judgments on the acceptable numbers of variants and transparent multi-variant analyses differed among the experts, as well as the choice and acceptance of meta- or sum-parameters as produced by holistic research approaches.

Finding common interpretations of the mentioned results

Subsequently an effort was made to find common interpretations of the mentioned results among the experts consulted, to serve as a preliminary conclusion. For some, the results from all reports (case reports, animal feeding and product analyses) were so much to in line with one another that, although criticism on each was fairly possible, the mutual support was overwhelming. However, for others precisely the flaws of each single report supported their scepticism. As the workshop participants all had their own position between those two extremes, a common opinion on the positive health aspects of organic food could not be reached. What all agreed on was that the issue was very interesting indeed and needed thorough multidisciplinary elaboration, both for scientific and social interest. Some proposals for strategic research could be indicated (6.).

Discussion

This state of the art was characterised by some experts as reminding of long-time scientific deadlocks on such hot issues as smoking and cancer, environmental pollution of specific industries, nuclear waste disposal and over-exploitation of natural resources. Also there renown scientist can take opposing stands on the same issue, facing the same evidence from different points of view, different disciplines, research conventions, and even paradigms and research interests. And it may be clear that the idea or notion that organic production might have a positive effect on the consumers' health has enormous consequences for society, affecting the positions of national health, food quality and agriculture authorities as much as the whole food industry.

Part of the paradigmatic discussion draws on factor thinking versus systems thinking. In the first, nutrition is a physico-chemical process with nutrient uptake as the key issue. Nutrients are molecules or complexes of molecules, which as such are as neutral as they are after chemical analyses, when all reminiscence of the nutrients' origin have been cleared away. Digestion is the process in which the organism makes the nutrients available from the products in which they are contained. Carbohydrates, proteins, vitamins and micronutrients are what we eat, together with some fibres to facilitate transport in the digestive tract. Whether the any of the nutrients come from vegetables, grains, beans, meat, milk and fish or from (petro-) chemical industry, does not matter as long as the (bio) chemical composition is the same. They are the building stones that build the organism.

On the other hand, in systems thinking, for a living organism, no molecule or factor has much meaning in itself. All effects of nutrients depend on the conditions and circumstances of the eater and the eaten: where, when and how the organism takes the food, and when, where and how the food was grown and treated (transported, processed, cooked, served and eaten).

In the first view the parts determine the whole, in the second view the whole determines the parts. By and large, those two views go along with the opposite ways the non-organic and the organic industry tend to perceive matters relating to food & agriculture. In the study of Van Vliet (1998), the position is taken that both views can be made to merge when common and interdisciplinary research projects are conceived in close co-operation of dialogue minded representatives of both ways of thinking. As experienced elsewhere (Van Mansvelt and Van der Lubbe, 1999), different concepts and perceptions can be conciliated when a same object is studied together, in a co-operative interdisciplinary team.

Conclusion and recommendations

The study made by van Vliet (1998) was a first report on the delicate issue of health effects of organic food consumption wherein expert workshops involving representatives of institutions were involved at such a scale. The idea was to find out in how much the evidence already available in literature did meet the standards of institutional science, so as to legitimate recommendations to the institutional research and advisory policy. Screening for epidemiological, animal feeding and product analyses researches, the first were found lacking, the second small in numbers and the last numerous but highly diverse and controversial in their conclusions. However, the positive effects on animal health (reproduction, stress resistance) and the positive findings in product analyses (less negative contents, more valuable nutrients, better storage quality, more anatomical and vital structures) were found to be impressive, although not yet consistent nor scientifically flawless. Based upon these findings, the study could strongly recommend research programs looking for:

- Case studies on effects of organic food consumption in health risk groups such as babies and young children suffering allergies and senior citizens with digestive problems.
- Cohort studies on these risk groups.
- Intervention studies in families with predisposition for allergies (atopic constitution), running from early pregnancy to the baby's first birthday.
- Intervention studies in homes for senior citizens.
- Laboratory experiments on effects of extracts of diets made from organic and non-organic production, using such parameters as cell-growth, tumour promotion, choline-esterase depression and anti-oxidant potential.

Jan Diek VanMansvelt
(photo by Darryl Amey)

Moreover, animal-feeding experiments, using different stress conditions for the animals and combining chemical and holistic food analyses with animal physiology and animal behaviour, in an interdisciplinary project, would be quite elegant indeed.

Additional remarks of a preliminary, hypothetical nature

Looking back at the food quality study reported on, it may be striking that when talking of food, in the end it boils down to nutrients and or pollutants of some kind. Here the question may be posed in how much the scientific knowledge on these nutrients complies to the consumers' experiences when enjoying a tasty meal. And also the full function of our digestive activities may be reconsidered, questioning consumption as merely nutrient uptake or more.

Taste & smell as reliable tools for food quality assessment

Usually, the whole question about taste as revealing product quality is put down with the argument of subjectivity of human sensorial observation in general, with the additional argument of taste as a matter of convention (nurture & trends). Saying taste is subjective can thus mean each and both of two things: the unreliability of taste as a tool for quality assessment, well as the personal preference of each person for one or the other taste. This stand of scientists presumes that observation and preference are too much mixed in taste perception to give taste a serious role in food quality assessment.

On the other hand, the food industry involved in such products as wine, beer, tobacco, tea and coffee heavily relies on experts knowing how to use taste & smell quite consistently. The top cooks providing for "Haute Cuisine" should be included here. And the perfume industry as well. My point is that apparently these sensorial capacities can be trained to meet quite objective observation standards, just like other human capacities can be trained in a way open for appropriate objective judgement (making and appreciating music, photography or handling amino-acid extraction and analyses). In all these cases a feasible combination of the person's constitution (nature), education (nurture) and motivation is required to make him or her fit for the job. And inter-subjectivity makes out most of objectivity anyhow. So my first stand here is that organoleptical capacities can be trained, perhaps in a way similar to the adjustment of instruments used for chemical analyses.

And like voltage meters must be adjusted to the scale of the presumed voltage to be measures, and pH meters to the expected acidity and the required scale of precision, so must human taste and smell be adjusted to the refinedness of the taste to be expected. When people are used to taste fast food, the adjustment of their taste to haute cuisine standards may take a while and some serious training. Here the argument is about taste as an objective means for assessing the taste / quality of a product, apart from the person's personal needs or preferences.

Personal food preference as a tool to stay healthy

As far as the personal preference is concerned, which can change during the day, the season, the mental situation or biography, some people go as far as arguing that it can help a person to choose the right food to eat at the specific moment. "Listening to the stomach" then is a way to keep the doctor away. We can presume that the body registers the state of the constitution and knows by nature and or nurture what it needs to balance any bias in its physiology. This presumption would support the idea that following the need to eat more or less of this or that kind of product can contribute to peoples' health and quality of life. Although this notion is definitely not (yet) scientifically assessed, it nevertheless means a lot for those who listen to their needs and thus comply with this notion. I presume that here once again, like with our organoleptical capacities, experimental learning could increase the knowledge on the issue.

Digestion as a way of relating to what we are eating

A next set of questions arises when considering whether appropriate nutrient uptake is all we need for our health, or whether the process of digesting the food we eat has a function for our nourishment. One point of view is that the digestive process is there to break down the food to set the nutrients free from their complex bindings. Over-stressing this point one could say that nature failed to make nutrients ready for human use; liquid nutrient solutions would be the ultimate goal of food industry, just as hydroponics to some are the ultimate solution for sophisticated plant production. Another position would be to perceive the effort made in digesting as part of the experience made in eating. Just as the scientist can learn about the food in making analyses, so the body could learn from breaking down the food in the digestive process. Lets us consider for a moment how well balanced jogging and other physical training makes those trained stronger instead of weaker. Where we might think they loose energy, the experience is that they gain energy by working out. Similarly, within appropriate scales, it could be presumed that the effort of digestion strengthens the organism instead of only using its energy in a wasteful way. Metaphorically one could compare the energy and experiences gained in hiking a landscape versus motoring it. I guess many will agree that in hiking the landscape is met more intensely, and the energy gained much higher then in motoring. Obviously, motoring has its charms as well, as does eating fast food. The challenge is to state the different effects both concepts: fast vs. slow, close vs. distant, intense vs. superficial may have on the ways we meet the world and act in it. In my opinion, part of the philosophy of whole-food consumption is that it offers the nutrients in a "original" context, demanding quite some effort for its digestion whereby that effort exerted on the food is valued as a positive contribution to the consumer' health.

Food as matter in an information-loaded context: eating as meeting

As third notion to be considered draws on the fact that wines, whiskeys and many other products can reveal their origin, year of production as well as house of production (Region, Terroir, Chateau or Brand). A similar but less elaborated realm of products is that of cheeses, teas, coffees, tobaccos and other food and fancy products. The challenge of analysing such background information by (bio-) chemical means has to my knowledge not yet been taken.

However, the awareness of some kind of meaning related to the production site has increased considerable over the last decade, with discussions on the legitimate regional labels emerging.

Presuming we could imagine that place (site), time (year, season) and management (craftsmanship, attention, professional dedication) would be imprinted in the food's structure, fixed in its nutrient's (molecular) composition. Would we then not somehow read that compressed information when analysing the food while using our digestive tract, from selling and tasting down to the so called food-breakdown?

Hard as it is to indicate scientifically accepted methods to assess such information, it seems hard as well to definitely deny that the plants and animals we use for food products did live under environmental conditions that influenced their way of being. Whether their life was stressed or relaxed, healthy or chronically in need of medication viz. pest control, their whole body, and all their organs, and cells witnessed the life they lived. Who ever visited farms, orchards, vegetable gardens etc. can tell how the atmospheres of different production sites can differ, and change over time for better or worse.

And although it is hard to imagine how that interactive complex of features: region, season and person, influences the products we eat, it seems hard as well to explain ourselves that they do not make any difference at all.

Reliability in food production, processing and presentation

It seems important to stress that the four points of view addressed above do quite obviously demand that the food as tasted, smelled and consumed does in its quality indeed reveal its own, intrinsic state of being. The moment we start adding whatever properties to the products that are alien to their own intrinsic being, we can easily step on moving grounds, making ourselves vulnerable to cheating and misleading. I think the whole whole-food movement can be understood as based on a notion about the importance of original values of the products. Reconstructing novel foods, by assembling tastes, smells, vitamins, carbohydrates, minerals, proteins and oils viz. fats, are seen as a 'tasteless and misleading' way of food production, at least in the perception of those appreciating the for before mentioned aspects of nutrition. Especially in a time that so many products can be re-constructed and re-combined on basis of petro-chemistry, the rationality that only the chemical composition counts for nutritional value, needs some hard arguing against a feeling that something got wrong in the way we perceive our nutrition. I presume that a look at today's revival of natural fibres in clothing, after years of petrochemical artefacts replacing them, can indicate a similar renaissance of natural foods appreciation in the near future. The regional products' re-appreciation, with the revival of regional production labels as indication, now in a controlled version, is in my opinion a step in that direction ('Appellation regionale'). For example the so-called 'Parmesan' ham or cheese respectively from pigs and milk imported from the Netherlands is then to be excluded as misleading the consumers. But, as you know, in view of historical developments and rights derived from habits, such regional indications as Gouda and Bourgogne have been taken as product labels in their own right. Whereas the Champagne-lobby succeeded to restrict the Champagne label to sparkling products from the grapes grown in the Champagne area. In this whole discussion natural sciences like nutrition and biochemistry play a minor role, as the clue of regional product quality assessment through chemical or biochemical analyses is not yet fully developed. It probably will not be developed on short notice either, as the financial interests supporting such methodology are small as compared to the interests in global food production and distribution. Here I think we can see a mechanism similar to that discouraging the development of regional seed varieties in plant or animal breeding, and that discouraged the development of species-specific pesticides in plant protection in earlier days.

Food quality perception and industrial interests

As short last word on the trend to make tough production rules for hygiene to prevent large scale food pollution –by micro-organisms, heavy metals, pesticide derivatives or other contaminants. This specially regards the regional on-farm (small scale) processing craftsmanship and its 'intrinsic dangers' as seen & advocated by those in favour of anonymous large-scale systems, using bacterio-phobia as a tool in their competition. In the 1st Slow edition of 2000, several authors discuss the issue under the theme 'Clean an dirty' (Slow, 2000). Let me just say that here the concept of problem prevention, as implemented from the food processing industry's point of view, shows a troubling side. I mean that relatively small farmers that have worked clean and safe on a low level of technologic sophistication for decades now are confronted with requirements they do not need and can not pay either (Richards 2000). So they are organised out of business in favour of less clean working colleagues who can afford to pay costly technology to cover the less nice-and-tidy way they work. Similar trends can be observed in other areas of society, where for example rigidity in education increases as a means to prevent the damage done by bad teachers, however with a discouraging effect on many more good teachers who get corseted in the rules of the control system. I guess that minimising the distance between producers and consumers, counteracting the anonymity of the producers in the eyes of the consumers and processors, is the only way out of the technology overshoot. Awarding the positive, the wanted, to me is much more effective then punishing the negative, the unwanted (Van Mansvelt and Elzakker, 1994). Here again, the slow food foundation pops up as an ally of the organic food industry (production, processing, trade, retailing and consumption). Beside the points made, co-operation of small (on farm) processors to increase the scale of their enterprise in such a way that the costs of 'hygienisation' can be carried seems an acceptable way out in several cases as well. It may even help to improve the social resilience of the farming enterprise, provided co-operative capacities are present or get developed in the farmers.

Concluding

I think that, long before science has found transparent access to such questions as presented above, many consumers will have gathered their personal experiences by getting aware of how they feel in preparing, eating and after consuming products form different origins and production systems. And as organic agriculture, as a system, particularly values and cares for the optimal interaction of site, season and individual dedication to the healthy development of soils, crops and husbandry, it may well be that the consumers learn to appreciate its qualities long before science does.

I presume that the food industry can contribute to the consumers' awareness by communicating the message they stand for, while on the other hand giving incentives to science to do relevant research. If those leading managers of food industry present would sit together and phrase their needs for research and their willingness to share –part of- the research in say the next four years, considerable clarity on the qualities of organic food could be presented.

Do not wait for the science system. Sit together. Take your own responsibility as an innovative industry. Establish an "Organic Food Quality Research Centre" (OFQRC) and speed up the food quality clarification process yourself. For your self and your consumers. In favour of a healthy organic health-food system. ✪

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SPEAKER PROFILE

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He is educated as a biologist, specialised in organic and sustainable agriculture and proceeded to sustainable land use and landscape management. He co-operated in several EU research programs on agricultural and landscape issues. He initiated a successful EU Concerted Action, delivering a "Checklist for Sustainable Landscape Management" in 1999. The identification of options for synergy within the range of land use actors in a region, analysing their respective requirements in the context of multifunctional land-use, is his actual expertise. Based on his lengthy experience and generalist knowledge, he can facilitate the dialogue between experts of various disciplines toward consistent policies.

Beside his work in academia, he is on boards of national and international NGO's involved in sustainable land use.

PUTTING BREAST CANCER ON THE MAP

— HELEN LYNN —

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We included this presentation in this publication because it gives a different perspective of the discussions about pesticides and endocrine disrupting chemicals.

I am here today to bear witness to the state of breast cancer activism and advocacy in England. Let me begin by stating a few statistics about the incidence and mortality rates in the UK:

- 1 in 5 female cancers are breast cancer and it is one of the most common cancers in ethnic minority groups.
- 1 in 12 British women will develop breast cancer during their lifetime and it is the commonest cause of death in women aged between 35 - 54 in the UK.
- In 1991, 34,000 women were newly diagnosed with breast cancer, 300 of these women will die each week.

Mortality rates have fallen over the last five years but incidence rates have risen The mortality rate still remains one of the highest in the world. We need to ask ourselves; why? In 1995, women decided it was time to unite their struggle for better breast cancer treatment, prevention, care and research. Taking inspiration from the American model, a United Kingdom Breast Cancer Coalition was born. This coalition comprises women who have breast cancer, health care professionals, researchers, scientists, environmentalists and all those with a common interest in seeing breast cancer firmly placed on political agendas and in the public arena.

On the 31st of October 1995, 300 women stood silently outside the Houses of Parliament to signify the number of women who die each week of breast cancer. This was the beginning of the UKBCC. On the same day the Scottish Breast Cancer Campaign delivered the last thousand postcards to the Prime Minister in Downing St. Well over 125,000 of the pink postcards had been issued and delivered to the same address from women wanting better health care, a voice in the decision-making process and a seat at the table. WEN also delivered a petition of over 80,000 signatures to the Department of Health calling for a National Action Plan for Breast Cancer which encompassed better treatment, care and primarily prevention in the UK. These petitions and postcards joined the thousands of others that have been submitted over the years in the hope that we could achieve a country-wide standardisation of treatment and make more funds available for research into causes and prevention of breast cancer. We have had little response from the government and no invitation for participation.

However, consumer groups in the UK are achieving success. After years of successful campaigning, RAGE (a voluntary organisation comprising women who have been damaged by radiation therapy), have produced a report in response to the Bates-Evans report produced by the Royal College of Radiologists. RAGE's report highlighted some major errors in the Bates-Evans version and has been widely distributed to members of the profession who have received it as a very comprehensive, well-researched and in some respects, superior document.

In the UK Breast Cancer Coalition, the Treatments Standards and Services Committee members are looking at getting a seat at the table during the consultative process for new drugs and therapy regimes. They have placed their foot firmly in the door and won't remove it until heard. Breast cancer charities are becoming more aware of the need to focus on environmental issues. Their interest is supported and stimulated by their membership. While trade unions such as Unison (a public sector union), have passed resolutions calling for a ban on Lindane, which is an insecticide and a oestrgogen mimic. It is manufactured by the same company that makes Tamoxifen.

I realised while collecting the petition that women wanted and needed to put breast cancer firmly on the map. They also needed to design the guide books in conjunction with all groups that have a genuine interest in breast cancer treatments, prevention and research. During this time I spoke to one woman who tried to explain to me how she felt about her diagnosis. She said "Breast cancer is like being in a foreign country without a map." This was the inspiration for the project that has come to fruition this year, funded by the National Lottery. One of the most important elements of the project is the possibility of different groups uniting in a common purpose no matter what the individual agenda.

Women in the UK also wanted to be active in campaigning and discussions which ultimately would serve to benefit them, their families and their communities. And in doing so, raise awareness, stimulate participation and generate a network of other local organisations and groups. One of the most fundamental parts of the breast cancer mapping project will be the compiling of maps of peoples' lived environment. Their homes, places of work and worship, their routes to shops, parks, community centres and leisure spaces. Maps are one of the earliest forms of self-expression and a clear focus for discovering and exploring change. Over the centuries they have become formalised and stagnant. We need to reclaim them.

These maps can be created from either an individual or community perspective and can be utilised by women who want to make an extensive study of their own localities. A questionnaire will also be collected with any background information gathered during the research process. Both the questionaire and the map, collected from different localities around the UK, will be entered onto a centralized GIS (Geographic Information System) based at WEN. The culmination of the project will be a map of the UK highlighting any links between breast cancer incidence and local pollution sources.

Given that women's health is a very good indictor of the state of the environment in any locality, this will be a powerful political tool for women and their communities to speak out about concerns for their health and environment. The evidence to support this project and others like it has come from the women themselves, many know the contributory factors to their breast cancer and few are listened to. Women want to take back control of their own "wild womanly hormones." We do not need to rely on pharmaceutical companies to modulate them for us.

In certain areas of England the incidences of breast cancer are 40% higher than the national average. These areas are intensively farmed and have a large industrial belt. These levels are well documented yet nothing has been done to find out why.

In several small valley communities in the UK, 50 women with breast cancer are bringing a court action against three industrial processing plants which place their valleys in the centre of a highly polluted triangle. A very high percentage of the male factory workforce have bladder cancer and many of the local women have breast cancer. This case is currently under investigation and the community will be participating in the mapping project to support their case.

An ICI factory in middle England has been severely fined again this year by the Environmental Agency. Talks with the company failed to stop the accidents that continually occurred at the plant. Spillage is a weekly if not monthly event. Residents fears are turned to anger - they will be making a map of the site and the surrounding countryside.

Polluted soil, water and air can contribute to a myriad of other health problems such as allergies, cancers, nervous system and reproductive disorders. If we raise awareness about breast cancer and the environmental links then we can all ultimately benefit from a healthier world.

In the Netherlands, women have developed an environmental database which collects information via the phone from people who have environmental illnesses or have experienced symptoms linked with chemical exposure. All symptoms are coded and classified and the database used to lobby the government for change. This has been a very successful program and I hope to utilise their codes to put the mapping project on a more international footing and to encourage other organiations and individuals to do the same.

We've got to recognise that, individually we are powerful but collectively we are invincible. A global network is the culminate strength and a collective pool of information of the individual contributors. It can also be a crucial lifeline for individual activists on the often lonely and unsupported road they follow when campaigning.

The evidence for environmental contribution to breast cancer incidence and mortality, is, in my mind, indisputable. We cannot wait any longer, we have to be instrumental in implementing change now. I can only echo all of the presentations we have had the privilege of listening to over the last three days and offer them to you as valid, concrete and indisputable proof that the time is now to do the only thing that is right and honest.

These are some of my suggestions for the Global Action Plan:

- To phase out, quickly and thoroughly all known and suspected estrogen mimics and hormone disrupting compounds from our environment.
- To set the standards for emissions and exposure rates to chemicals throughout their lifetime of production, usage and disposal. We need to look at who set the standards, the public or the scientific community. With the poor understanding shown by the medical or scientific community toward people with Multiple Chemical Sensitivity (MCS), Allergies, Gulf War Syndrome and ME, the weight of public opinion is very low, we need to give it more credibility.

  Levels should be set for the protection of the most vulnerable elements of society. The health of those most sensitive to pollution: women, children and the fetus should be considered as well as those with certain conditions and illnesses aggravated by pollution. They should be used as average baseline or as canaries in the mine.
- To remind governments who have already agreed to binding international agreements in terms of cleaning up emissions via air, water and soil, that they have to adhere to their promises and be accountable. For example, "the North Sea declaration." We won't be silenced until this is achieved.
- To work with government, medical and public health organisations in order to review the language of breast cancer to redefine terms which have fallen into casual and misleading usage. Thus "prevention" must mean avoidance of the disease, not detection by screening or a diagnostic method. The term "cure" to be used only when there is complete removal of the disease not local control, remission or non-recurrence. And finally, "environment" which means for many women the total environment in which they live and therefore includes factors not yet considered by the experts to be causal e.g .local air and water pollution, synthetic hormone disruption in the form of chemicals used in food production and processing, agricultural control of the natural and insect world etc.
- To direct research towards developing an accurate scientific test to identify estrogen-mimicking chemicals which may affect both humans and animal species. This needs to be a priority, given the urgency of the problem.

- Environmental standards are set for harmful chemicals in isolation, ignoring the real life situation of a complete mix of chemicals inhaled and ingested from the environment. Cocktail effects must be researched, considered and accounted for when setting standards.

- The polluter must pay, either in the form of taxation for the manufacture and disposal of hazardous substances. Currently in England a system of BATNEEC - (Best available techniques not entailing excessive costs) influences BPEO (Best Practical Environmental Option). We have to revise this outdated notion to ensure that the benefits always outweigh the cost.

- Emphasis on the economic practicalities of choosing more sustainable and less polluting consumer items must be applauded and encouraged by both the government and corporate industry.

- Industrial processes must be cleaner, less wasteful and more self-sustaining, ensuring adequate information is available to the general public on emissions of potentially harmful chemicals. The public should have an informed say as to what they think are "acceptable" levels of harmful chemicals in the environment.

- And lastly, I think breast cancer is a human rights issue and what is happening to women is a violation of these rights and therefore discriminatory. I propose that breast cancer is documented as such and all cases treated as an infringement on the rights of women.

Thank you. ✪

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SPEAKER PROFILE

The Women's Environmental Network is a charity, which aims to educate, inform and empower women who care about the environment.

Helen Lynn *from WEN presented the following Evidence for the International Hearing at the World Conference on Breast Cancer in Kingston, Ontario on the17th of July 1997.*

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REDUCING RISKS FROM E. COLI 0157 ON THE ORGANIC FARM

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This paper was written as a request of Eleanor Heise, then the president of Canadian Organic Growers Inc (COG). An abbreviated form was published in COG's publication 'Eco-Farm & Garden' in Summer of 2000 and can be viewed at http://www.cog.ca/efgsummer2000.htm#ecoli.

This article is still very timely, because the threat of microbial contamination of food and water is a major concern. Many researchers have made the point that the wide spread risk of E. coli 0157 poisoning is a result of the industrial food system. The latest book (2001) on this subject is: 'Fast Food Nation' by Eric Schlosser.

Ironically, one of the most venomous opponents of organic agriculture, Dennis Avery of the Hudson Institute, claims that organic agriculture is responsible for much of the microbial contamination of food. This claim has no validity, a search on outbreaks of food poisoning at the Center for Disease Control and other sources reveals that the opposite is true.

I believe that this article give the information we need to refute some of the hostile claims made against organic agriculture.

—Hart Haidn, May 2001

Summary

E. *coli* 0157 is a bacterial pathogen of the human intestinal tract which is carried in certain species of livestock and wildlife without ill-effect. Such organisms are termed zoonotics. Various types of *Campylobacter* and *Salmonella* are other major causes of food borne illness that like E. *coli* 0157, are zoonotic in livestock and appear to have been on the increase in recent decades. E. *coli* 0157 is particularly hazardous because of the very low number of organisms that can cause infection and because of serious complications that can result from infection, especially in infants and the elderly. As well as from contaminated food, E. *coli* 0157 can be acquired through casual contact with manure and with fecal contaminated surfaces and water. Thus farm residents and workers should be aware of the nature

of *E. coli* 0157 and of personal measures they can take to reduce the risk of infection. Reducing the levels of zoonotics in farm animals is seen as a key component of strategies to reduce the occurrence of food borne infections generally. A number of the existing practices of organic farming could be expected to discriminate against *E. coli* 0157. However, none can ensure its absence and the routes by which 0157 moves into farms apply to organic farms, for example via birds that have been feeding on a farm with a high level of *E. coli* 0157. Some provisional guidelines for reducing levels of *E. coli* 0157 on organic farms and the risk to farm workers and residents are offered. They are pertinent also to gardeners who use manure or buy bulk compost.

INTRODUCTION

The occurrence of human pathogens in livestock and livestock manure is a concern to livestock farmers, to stockless farmers who use manure as a soil amendment, and to all of us as consumers. Of increasing notoriety is a nasty bug known as *Escherichia coli* 0157:H7, which I will call 0157 for short. Dennis Avery, the perennial critic of organic farming contends that organic produce is more likely than conventional produce to carry this and other harmful bugs because of the use of manure on organic produce (1). Aside from failing to present any comparative data to support his argument, he chooses to overlook some key facets of organic production- such as the requirement to compost or age manure - that could be expected to make it much less susceptible to carrying pathogens than systems that do not have such requirements. Regardless, it is an issue that the organic community must take seriously, both to battle the perception that organic could be more susceptible to food poisoning, and to ensure that is not the case. One big factor we have going for us is that as a result of certification, "organic" is a well defined system and a structure is in place for disseminating information, and as necessary, ensuring that prescribed practices are followed. This article examines some of what is known or suspected about the occurrence and survival of 0157 on farms and in produce and its relevance to organic farming. Research into the epidemiology and prevention of 0157 on the farm is just beginning, thus mostly what can be offered in the way of prevention are guidelines that apply to prevention of spread of food borne zoonotics generally. Zoonotics are organisms that exist naturally and usually without ill effect in animals and can be transmitted to humans under natural conditions, causing disease. Various types of *Campylobacter* and *Salmonella* are other major causes of food borne illness that are also zoonotics in farm animals, and like 0157 have been on the rise in the last 20 years (2).

What is *E.coli* 0157?

E. coli is a normal inhabitant in the intestine of humans and animals. The number of *E. coli* in a sample of water is a commonly used indicator of fecal contamination. A minority of the strains are pathogenic including 0157, which produces a "vero" or "Shiga" toxin which breaks down the lining of our intestines and can damage kidneys. Symptoms are bloody diarrhea and abdominal cramps (or sometimes non-bloody diarrhea or no symptoms at all). Usually little or no fever is present, and the illness dissipates in 5 to 10 days. A more serious complication called hemolytic-uremic syndrome (HUS) can lead to kidney failure and death; it occurs mostly in children under 5 and the elderly. The Center for Disease Control in the U.S. suggests that anyone having sudden diarrhea with blood should get their stool tested for O157. It is estimated to affect 73,000 people and cause 61 deaths each year in the U.S. (3). In many regions of Canada, 0157 is the second most common bacterial pathogen in stool specimens submitted to clinical laboratories (first is Campylobacter), moving into first place during warmer months. 75-90 episodes of HUS occur in Canada each year, most of them between April and September (4).

Most 0157 infections have been associated with eating undercooked ground beef which was contaminated through contact with feces in slaughterhouses. However, infections have also resulted from ingesting 0157 in water and other foods, (3, 5) including:

- reservoir and recreational water
- raw milk
- unpasteurized apple juice/cider
- sandwiches
- lettuce
- dry cured salami
- produce from manure-fertilized gardens
- handling potatoes
- radish sprouts, alfalfa sprouts
- yogurt
- undercooked poultry, venison, lamb

Contamination of non ruminant food sources is usually attributed to contact with ruminant manure at some stage (6). Tests have shown that once introduced to lettuce and other vegetables, survival and growth under permissive temperatures is highly likely. *E coli* 0157 is unusually acid tolerant and so can grow in low pH juices (7).

An exceptionally low dose of 0157 - 2 to 2000 cells - can cause infection (5) (versus 10,000 to millions for most salmonellas (2,8)), which makes handling of contaminated materials particularly hazardous. Once introduced into a family or closed group, it can be spread by person-to-person transmission, especially by children who are not toilet trained. Young children shed 0157 in their feces for 1-2 weeks after their illness resolves; older children rarely carry 0157 without symptoms (3). Increased attention to handwashing, and particular care handling diapers (and undergarments from anyone with diarrhea) are important once infection is identified within a group (4).

Food handling: consumers' first line of defense

Precautions that apply to reducing contamination of food generally apply to 0157 (2,4,5), i.e.

- proper washing of hands before preparing food
- washing foods and preparation surfaces
- cooking meat adequately (no pink meat: internal temperatures should reach 160°F/71°C for ground beef, chops, and 180°F/82 °C for whole fowl)
- thawing meat in the refrigerator or under cold water
- not consuming unpasteurized milk
- being careful to separate raw meat from other foods in the refrigerator
- minimizing storage time of cooked food (in the refrigerator or out) before consumption.

Storage of food at room temperature and preparing food too long before consuming allow organisms such as *Salmonella* to multiply and reach critical levels, and are the most common cause of food poisoning (2). Temperatures of 8°C and higher are conducive to growth of 0157 and may increase infection potential, however, storage at 5°C (standard refrigerator temperature) on its own offers little protection against 0157 because of the low dose required for infection (9). There seems to be considerable potential for use of natural food additives such as garlic, cinnamon, oregano, sage and cloves to suppress 0157 in some foods (10). New strains of *Lactobacillus acidophilus* effective against 0157 are being developed (11).

E.coli 0157 on the farm

Industrialized farming practices are considered to be a factor contributing to increased levels of food borne illness associated with zoonotics (2, 12).

Regardless, it is safest to assume that most of these organisms, including 0157 are everywhere including organic farms. According to Dr. Dale Hancock of Washington State University, " *E. coli* 0157 is widespread in nature, occurring naturally and sporadically in the gastrointestinal flora of humans, cattle, deer, sheep, dogs, horses, birds, and perhaps other species." (13) The specific routes by which 0157 arrives on a farm are not known although birds, deer, other wild animals and livestock brought in from other farms are suspected (14). Ruminants appear to be the primary reservoir. For example, a study in the UK found 0157 in 15.7% of cattle (dairy and beef), 2.2% of sheep, 0.4% of pigs and none in chickens (1000 of each examined) (15). The strains in pigs were non-toxigenic. Other studies have also revealed low incidence in pigs and poultry , compared to ruminants, but they have included toxigenic strains; thus while less important than cattle in the epidemiology of 0157, pigs and fowl cannot be assumed to be free of toxigenic 0157 (16). Improved detection methods indicate very high incidence of 0157 in cattle; for example, a 1999 study in the midwest US revealed 0157 in 27% of fecal samples from cattle brought to slaughterhouses during summer; 72% of the 29 lots (individual farms or feedlots) represented in samples included at least one animal positive for 0157 (17). Post-processing frequency was 2%. Single strains (isolates with the same molecular fingerprint) often dominate a herd at one time suggesting a common source (e.g. drinking water), but can change over time indicating import of new strains (e.g. via birds) (6, 14). Over the course of a year, weaned calves and cattle may intermittently carry and not carry 0157. Immature cattle carry higher levels of 0157 than mature cattle. Shedding of 0157 in feces from an infected animal occurs over periods of weeks to months (18). Studies have usually demonstrated a strong seasonal influence on occurrence of 0157 in cattle feces (14, 18). For example, over a year long study in England, O157 was isolated from the feces from 38% of cattle presented for slaughter in the spring, but only 4.8% during the winter (15). Reported incidents of 0157 poisoning are correspondingly seasonal (3,4). Although the prevalence of 0157 may seem alarming, food borne pathogens are something we have always lived with and different cultures have evolved a wide variety of practices to reduce the chances of food poisoning (2). If there is a single factor underlying what seems to be increasing incidents of food related bacterial diseases, it is a kind of globalization of impatience with the procurement and preparation of food (2,12). We want everything there is from everywhere, and we want it now and we want it cheap, which means cutting corners on the production side.

REDUCING OCCURRENCE AND RISKS OF *E.* COLI 0157 ON THE ORGANIC FARM

Research into the life history and prevention of *E. coli* on the farm is just beginning, and for now, mostly what can be offered are guidelines that apply to zoonotic pathogens generally. What we do know about *E. coli* 0157 - notably its high toxicity for children and the elderly, its low infection dose, and its common association with healthy ruminants behoove a highly precautionary approach.

Handling and processing manure

Fresh manure, particularly during summer months, has a high probability of carrying 0157 and other pathogens. Thus special precautions should be followed in handling fresh manure, such as wearing protective clothing, avoiding hand contact with the mouth, eyes and nose, and washing after handling livestock and manure. Activities of small children in the vicinity of livestock and manure should be carefully monitored and directed (if allowed at all: in Sweden and the UK it has been recommended that children under 5 do not visit livestock farms (19)); farm families need also to be aware that farm companion animals can transmit 0157 to humans (18). Hides are readily contaminated by fecal materials, and can be a source of 0157 in slaughterhouses (17), thus livestock should be as clean as possible before being sent to the abattoir.

Composting, a key component of organic farming, is a pathogen reduction process. Under experimental conditions, most bacterial pathogens are killed by exposure to temperatures of 55-60°C for a few hours or less (8). Such temperatures are achieved and last for days to weeks in the thermophilic stage of composting. Canadian commercial compost standards require that under windrow composting a temperature of 55°C or greater is maintained for at least 15 days during the composting period and that during this period, the compost is turned at least five times (20). For industrial composting systems in which the composting process is conducted indoors, is closely monitored and controlled, and for which different sets of equipment are used at earlier and later stages of processing to avoid reintroduction of pathogens, a high degree of consistency in the elimination of pathogens can be achieved.

With many or most farm composting systems, there is less control over the process and it is more difficult to ensure uniform exposure to high temperatures without overheating. This increases the importance of other factors in the destruction of pathogens. Colueke (21) cites four:

(i) antibiosis (suppressive effects of other microbes)

(ii) physical and chemical changes e.g. in pH

(iii) competition for nutrients with the normal compost flora and destruction of the pathogen's original nutrient supply

(iv) time

How well the pathogens get exposed to these agents is a function of the method of management, which he discusses in some detail for windrow, static piles and mechanically mixed compost. Regardless, he says that even when all pathogens are assumed to have been killed, prudence dictates a certain amount of caution. If pathogens do survive, their survival under field conditions becomes another factor. He says that if sewage sludge or other forms of body wastes are composted, then complete destruction of pathogens is essential before the compost product can be safely used for row crop and leafy vegetable production, that is if the vegetables are destined to be eaten raw. He goes on to say "Unless a span of at least a year is involved, such compost should be pasteurized." He emphasizes in several places the importance of time to allow lethal factors and mechanisms to exert their full effects. "Our work and that of others demonstrate that time can substitute for frequency [of turning]."

Thus the usually applied organic standard that untreated manure must be aged before application to food crops is consistent with this principle, and should be strictly adhered to. Allowing time for proper maturation (curing) of compost is also important. Two to four month curing times have been suggested for backyard composts to rid them of 0157 (22).

It is very important not to reintroduce pathogens into matured compost by mixing it with uncomposted or immature compost.

Aeration, independent of heating, appears to suppress 0157 in manure. Kudva et al. (6) found 0157 after more than one year in a non-aerated ovine manure pile, however in experimentally aerated ovine and bovine manure, it was not found after 4 months and 47 days respectively. The aerated piles were small, and the authors speculated that drying cycles were responsible for pathogen reduction; they remarked that "*E. coli* O157:H7 was never recovered from the dry top layer of any manure pile."

In the discussion section of their paper, Kudva et al. (6) attribute some of the increase in food borne pathogens to the increased density of animals on farms and the development of quick methods for disposal of wastes, notably use of slurries versus traditional methods employing bedding and composting. They remark that "Farm effluents should be contained in holding tanks with proper aeration for appropriate lengths of time (1 to 3 months or as required) before being used as fertilizers... Improperly incubated and/or stored slurry can serve as a vehicle for environmental spread and propagation of pathogens that may include *E. coli* O157:H7."

Composting and curing, aging of uncomposted manure and aeration of slurries are obviously important for use on food crops, but may be important even for forage crops in order to reduce levels of 0157 in livestock. *E. coli* 0157 survives much longer in manure products than in the live animals, and thus manure contaminated materials are suspected to be a reservoir of 0157 for reinfection of livestock (6). Contradicting this expectation, one study found that application of manure to forage crops was not associated with prevalence of *E coli* 0157, nor was feeding on pasture versus feeding on dry lots (23). Nevertheless, until there is much more conclusive evidence on this score, a highly precautionary approach seems advisable.

Feed and Water

Drinking water for livestock has been clearly demonstrated as a conduit and possibly the main conduit for transmission of 0157 from one animal to another, and it appears that water can be contaminated by oral contact alone (24). Dale Hancock at Washington State University, who has conducted extensive research into the occurrence of 0157 on farms is convinced that survival and multiplication in feed and water troughs are major factors affecting levels on the farm. He is cited (13) as offering these two "top tips":

- *E. coli* 0157 grows in wet feeds, but growth can be stopped by using mixed rations containing silage with high levels of certain acids;
- Frequent cleaning and appropriate sanitation of water troughs can potentially prevent replication and/or long term maintenance of *E. coli* 0157 in sediments.

Also, there is some evidence to suggest that use of small water reservoirs with frequent refilling is less conducive to 0157 than use of large reservoirs (24).

The significance of feeding regime for control 0157 is currently quite controversial. For example, Hancock and others dispute (25) a highly publicized study suggesting that feeding hay to cattle before slaughter could reduce incidents of 0157 in slaughterhouses. Thus for now, it appears that more reliance should be put on sanitation than on feeding regime as a primary line of defense.

Minimal use of antibiotics

In a study of a cohort of 15 heifers on each of 4 Wisconsin dairy farms differing in management, 0157 was not observed in once weekly sampling over a 14 month study period on the two farms that used antimicrobials only occasionally and made no use of sulfonamides, while cohorts tested positive on the 2 farms where antimicrobials were used. There were other differences between the management systems, notably in the regimes for providing water, that could account for lack of 0157 on the two farms, but the authors remarked that antimicrobial use could be a risk factor for 0157 shedding in cattle, and that further research is required. Of the two farms on which 0157 was found, the highest level of antibiotic resistance in 0157 was found on the farm with highest use of antibiotics (24).

Probiotics

Probiotics are infusions of beneficial bacteria that can survive the stomach acids and become established in the intestine where they counteract, in some way, harmful bacteria, or have other beneficial effects. They are frequently used to establish desirable organisms in young animals (we are all born without intestinal bacteria), and after antibiotic treatments have eliminated desirable as well as undesirable organisms. A scientific study found one commercial product to be effective in reducing caecal colonization of chicks by both a poultry pathogenic *E.coli*, and by *E.coli* 0157 (26). Probiotics are more difficult to use this way with older ruminants because of the high levels of native bacteria, however, effective products may be available within a few years (27, 28). Commercial strains of *Lactobacillus acidophillus* specifically antagonistic to *E coli* 0157 are being developed (11).

Survival in soil

In general, survival of pathogens in soil is strongly reduced in non-sterile compared to sterilized soils, in soils that undergo periodic drying compared to constantly wet soils, and at higher temperatures compared to lower temperatures (8).

A special role for earthworms?

J.L . Spencer (29) reviewed studies including his own on effects of vermicomposting on pathogens. Worms feed on microbes, and enhance the microbial activity. Resistance of chicks to intestinal colonization by *Salmonella enteritidis* and *Salmonella typhimurium* was greatly increased if they were fed a small quantity of vermicompost produced by earthworms fed chicken feces. Spencer also notes studies indicating that earthworm activity contributes to the elimination of *Salmonella* and other pathogens in soil.

Treating liquid effluents

Liquid effluents containing fecal materials can contaminate downstream surface waters, posing hazards to the public or other farms; if recycled on the farm for irrigation, washing, flushing or use as a water source for livestock, they may contribute to maintenance of high levels of 0157 and other pathogens. Lagoon treatment systems combined with constructed wetlands are highly effective in removal of pathogens; presence of vegetation enhances removal compared to systems without vegetation, and efficiency of removal increases with species diversity of the wetland vegetation (30). There appear to have been few studies specifically on removal of 0157. Based on survival of *E. coli* 0157 and *Salmonella* inoculated into water samples from a lagoon-wetland system, McCaskey et al. (31) suggest that wastewater stored in lagoons and/or treated in the wetlands for a combined period of 20 days is safe for irrigation and cleaning purposes.

CONCLUSION

From what we know about 0157, there is no reason to suspect that organic produce is more likely to carry 0157 than conventional produce, and there is even some basis for hypothesizing that 0157 could be less common in organic than in conventional livestock systems. Several of the core practices and principles of organic farming - notably the aging and composting of manure, the general desire to operate systems as nearly as closed as possible and to market locally, the inferquent use of antibiotics, the emphasis on probiotics and maintenance of healthy microflora in livestock (and people) and of high levels of microbial activity in soils - could be expected to reduce the levels of 0157 on organic farms. Unfortunately, none can ensure its absence, and there appear to be no data on occurrence of 0157 on organic farms. The routes by which 0157 moves into farms apply almost equally to organic farms (e.g. via birds that have been feeding on a farm with a high level of 0157). Thus there is no basis for complacency and special precautions are still very necessary.

What worked in the past may not work today. As much as it may run counter to what were once valid notions of healthy food, children and persons with weakened immune systems should not consume raw milk. Good sanitation practices for livestock, harvest containers and contact surfaces, and postharvest washing are very important. Farmers and their certifying organizations should encourage improvements in composting systems to achieve uniform exposure to high temperatures. Curing of compost for 4 months, aging of uncomposted manure for a year, and aeration or composting of slurries (32) should be encouraged; it also produces better amendments. More specific and stringent regulations than currently specified in certification codes may be appropriate, at least until we have a much better understanding of 0157, and how it is affected by organic practices. Intensive testing is required to establish that 0157 is NOT present on a farm, thus organic organizations might consider collaborative projects and seeking assistance to investigate 0157 on organic farms.

Some provisional guidelines for reducing *E. coli* 0157 on the organic farm

- Ensure that farm residents, workers and visitors are aware of the nature of the *E.coli* 0157 problem, and of personal preventative measures they should take to reduce risk. *
- Prohibit or carefully supervise activities of small children in areas where they might be exposed to fresh manure. *
- Follow good sanitation practices for livestock, harvest containers and contact surfaces, and wash vegetable produce free of soil.
- Flush water troughs with fresh water frequently and clean them regularly.
- Consider whether imported manure is highly likely to contain *E.coli* 0157 (e.g. fresh ruminant manure from a feedlot). *
- Take care to prevent cross contamination of old or composted manure with fresh manure. *
- Make improvements to the composting system to ensure thorough mixing of compost during the high temperature phase. *
- Allow compost to cure for 2-4 months (or longer) after the heating phase. *
- Aerate slurries for 1-3 months, or compost them, e.g. with straw
- Age uncomposted manure for at least one year before use. *
- Clean hides of livestock before taking them to the abattoir.
- Process liquid effluents from the farm in holding ponds/wetlands for 20 days or more.

**Asterisked items apply also to gardeners making use of manure*

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SPEAKER PROFILE

David Patriquin is professor of Biology at Dalhousie University, Nova Scotia. A marine biologist by training, he became interested in organic farming in the 1970s through his work on nitrogen cycling and out of concern about the degradation of aquatic systems associated with industrial farming techniques. Organic farms are system level experiments in ecology, he says, and getting them to realize their full potential for producing food and nurturing the planet is the ultimate test of our understanding of ecology.

He has conducted on-farm research in collaboration with individual farmers and groups of farmers attempting to reduce reliance on agrochemicals or to improve functioning of certified organic farms, and has served as a Certification Agent for several organic farming organizations in the Maritimes and Maine.